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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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Forthcoming Events

APRIL 19

Institution of Welding Engineers (North-Eastern Branch):—Meeting at Neville Hall, Newcastle. "A General Survey of Metallic Arc-Welding, with Particulars of some Welded Products," Paper by D. G. Sinfield.

APRIL 25

Institution of Welding Engineers (North-Western Branch):—Annual general meeting, at 7 p.m., at the College of Technology, Manchester. At 7.30 p.m.: "Recent Developments in Atomic Hydrogen Welding," Paper by J. A. Dorrat.

Institute of British Foundrymen

APRIL 20

Sheffield and District Branch:—Annual general meeting at the Grand Hotel, Sheffield, at 7.45 p.m. "Alloys in the Ironfoundry," Paper by J. Roxburgh.
Birmingham, Coventry and West Midlands Branch:—Annual general meeting at the James Watt Memorial Institute, Birmingham, at 7.30 p.m. "The Mechanical Production of Cores," Paper by W. J. Molineux.

APRIL 26

West Riding of Yorkshire Branch:—Annual general meeting at the Technical College, Bradford, at 6.30 p.m.
Lancashire Branch (Junior Section):—Annual general meeting at the College of Technology, Manchester, at 7 p.m., and lecture.

What is a Metallurgist?

An American visiting England described a metallurgist as a person who extracted metals from their ores, and fabricated them into articles of commerce, and did so at a profit in contradistinction to a scientific investigator from whose work no profit accrued. Dr. Moore, in his Presidential Address to the Institute of Metals, referred to two types of metallurgists: one being the process-metallurgist and the other, we presume, a pure metallurgist. We suggest that this is a case of putting the cart before the horse, and that the "process" metallurgist is the pure metallurgist, whilst the "pure" metallurgist of Dr. Moore is a physical chemist. The American's definition is still the criterion upon which a metallurgist is judged. We regard all successful foundry managers as metallurgists, though they as individuals are divisible into two types—the scientific and the non-scientific. The latter may achieve excellent results consequent on empirical reasoning and profound experience. Usually they are labelled "practical," although, in truth, they are more theoretical than their technically-trained colleagues. Their theory, however, rests not on a scientific basis, but on observations from practice.

If a metallurgist is worthy of his designation he must produce profits, and to do so his knowledge of the working-up of metals into articles of commerce must be accompanied by a realisation of the costs associated therewith. Personally, when we left the University, we adopted the title of "metallurgical chemist," as we were engaged purely in the chemical laboratory of one of our vast metallurgical enterprises. Later, when we controlled production, then we considered ourself as a "metallurgist," and finally, when our activities were mainly devoted to the design and operation of melting plant, then we were of opinion that the designation "metallurgical engineer" was appropriate. We still respect Shakespeare's dictum, "What's in a name," but we do object to the physical chemist filching the appellation "metallurgist" and according the hyphenated title "process-metallurgist" to what is in truth the genuine article.

Ingot Moulds

The ingot-mould question is of perennial interest and the severity of service of the steel-ingot mould tends to attract attention away from the smaller ingot mould used for non-ferrous ingot and strip. The book recently reviewed in our columns and written by Messrs. Genders and Bailey contains a good deal that concerns the ingot-mould maker. For over a century cast iron has been used for moulds, and in the last few years there has been a tendency to go to other materials such as copper, and to water-cooled moulds, in place of cast iron. The maker who finds it so difficult to get an economic price for cast-iron moulds may wonder why users go to a much more expensive article. The reason is that the finish of rolled sheet is much more important than it used to be, and defects in sheet have been traced to defects in the original ingot which arise in the first place from the mould. A cast-iron mould is apt to cause blowing, as a consequence of which the gas from the mould surface enters the surface of the ingot. It was at first thought that this was due to graphite, but subsequent tests showed that this was not the case. It was, in fact, shown to be due to an interaction between the combined carbon or carbide in the iron with a film of oxide. The same effect was obtained from a high-carbon steel, and of course it is absent from carbide-free materials like mild steels and copper. Mild steels, however, are liable to warp and distort, and the rigidity of grey iron is a great asset. It would, therefore, be a profound mistake to let this market go on the assumption that it is lost. We suggest that the makers interested should act together and arrange for the Cast Iron Research Association to take the matter up and produce an ingot mould which gives reasonable freedom from the blowing defect. There is little doubt that it can be done, but it must be done by joint action, because only the makers can carry out trials on a manufacturing scale and induce users to arrange for proper application. There are certain obvious possibilities which are well worth exploring.

XUM

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

Water Core Binders and Coal Dust

To the Editor of The Foundry Trade Journal.

Sir,—One foundry is now working to determine the best methods of examining sand to ascertain the correct amount of acid to be used. The acid can be introduced in the water with which the sand is wet down, and such a small amount is necessary that it will not injure the hands of the workmen. Properly proportioned, the acid will all be expended in neutralising the alkalis in the sand, and there will be no free acid left in the mixture when it comes to the core shop. Along the line of the discoveries made with the well water as to the effect of alkalis on core binders, the writer has learned of some interesting facts concerning the water used in tempering and mixing core sand. A certain foundry was purchasing town's water, and everything was satisfactory, but the expense was a considerable item, and so they drilled an artesian well. The artesian-well water tasted very good and was beautiful to look at, but immediately there was trouble in the foundry. After some months of very unsatisfactory results, the difficulty was traced to the new artesian-well water. They changed and altered the moulding-sand and core-sand binders; still there was trouble. They finally discovered that, by going back to the town's water for mixing the sands and core sand and binders, the trouble disappeared. An analysis was not run on the artesian water, but it is evident that it was highly alkaline, and that this was neutralising the effect of the binders either by saponifying the oils or by affecting the strength of other binders used. From this and other cases which have come under my observation, I believe that in the future it may be found just as advantageous to treat water for core shops and foundries as it is to treat it for corrosion in the boiler room and bleaching works.

Binders and Their Binding Power

The foundryman buys binders on account of their binding power. If he then persists in using a sand or water which destroys a portion of this binding power, he forces himself to use a greater amount of binder, and it may be found much cheaper to treat the sand or the water so as to eliminate the interfering conditions. Another surprise that came during the investigation was a discovery relating to binding ratios; it is evident that, when a measured amount of dry sand is taken and placed with a measured amount of binder, owing to the fact that there may be more grains of sand present, the ratio between the sand and the binder will be higher than when moist sand is taken in the same measured amount, with a consequently smaller number of grains of sand. It is possible, with certain grades of sand and certain percentages of moisture measured in this way, to introduce variations of at least 25 per cent. in the binding ratio. For this reason, where accurate results are required, all of the sand should be dried previous to mixing. This is also important in order to obtain the proper percentage of moisture in the core mixture, as I have found that this is an important item.

The use of coal dust in moulding sand is decreasing, especially in the United States. Coke, being porous, is a rational thing to use. Coal is a producer of gas, and until the gas has been driven off it is non-porous and is thus an undesirable component.

If required at all, its proper place would seem to be in the blacking. Sawdust is sometimes used in place of coal dust to open the sand by burning out and making the sand strip the casting much better. This is best seen in the stripping of a core. There is no coal in core sand, and I do not see why there should be coal in moulding sand for mechanical moulding where castings are sand-blasted. Coal neither gives a bond nor permeability; it just forms a film between the sand and the casting. In time to come it will only be used in jobbing foundries where it is hand labour, and this is where the film is most required. Let us just take a look at the action of molten metal in entering the mould. At first the mould is filled with air and the moment the molten metal enters this air becomes highly heated and expands, thus instantly creating a pressure in the mould. The inflowing metal must not only expel a volume of air equal to the cavities of the mould, but the expansion of the air greatly increases its volume. Then also considerable steam is generated as the metal enters, and this too has to be expelled. This mass of air and steam escapes through both the mould and core, so I fail to see where coal dust is of benefit here.—Yours, etc.,

A. Sutcliffe.
1, Firwood Grove,
Tonge Moor, Bolton.

Modern Iron Foundry Practice

To the Editor of The Foundry Trade Journal.

Sir,—It is gratifying to know that the report of my Paper on the above subject, which appeared in the issue of your Journal dated March 8, has aroused sufficient interest amongst some of your readers to induce them to discuss by correspondence many of the points dealt with. The object I had in view in writing the Paper has thus been achieved, and I wish to thank those who have been good enough to contribute to the written discussion.

Mr. Neville's letter relating to the balanced-blast cupola is a case in point, and the fact that Mr. J. E. Fletcher has been good enough to reply to it will be welcomed by your readers for two reasons, firstly because it indicates that Mr. Fletcher has so far recovered from his long and serious illness as to be able to devote the necessary time and attention to doing so, and secondly because it deals with the matter in such an authoritative manner as leaves no room for doubt as to the principles underlying the invention, and gives details of the facts that have been proved by their application in practice, which will add greatly to the value of the information available.

In any case, it accentuates what I wished to stress, namely, that one of the main benefits to be derived from the use of the principle was due to the absence of an oxidising atmosphere with its detrimental effect upon the molten metal.

With regard to Mr. W. Tait's letter in your issue of March 29 relating to "Synthetic Sands," I must confess that my reference to the number of foundries in the U.S.A. that were using them might have been an under-estimate, and should have been qualified as follows:—"One or two of the foundries *that I have visited*." Nevertheless, my information is to the effect that it is the exception rather than the rule for American foundries to use "Synthetic" sands, the general practice there being similar to ours.

Of course, no foundry would be considered modern or up to date that had not made some suitable provision for routine sand testing, and the publications on this subject by the B.C.I.R.A. supply details of methods that it is hoped in the interests of founding generally may become standardised. So far, the experi-

(Concluded on page 256)

Random Shots

The influence of the foundry industry on our industrial development, and, therefore, in the last century at any rate, on the history of this country, is well known. Yet I was surprised recently to unearth a direct contact between the industry and the Birth of a Great Nation. I am not exaggerating. Did you know—Oh well, even if you did, it was news to me—that George Washington was, among other things, a foundryman?

* * *

George Washington's foundry stood on the banks of the Potomac River at Great Falls, Fairfax County, Virginia. Nearby is a canal built by the Patowmack Company, incorporated for the purpose, of which the great man was the first president. The interesting photograph reproduced in this column was very kindly sent me by Mr. Frederick Sillers, Junr., of Washington, U.S.A. I am afraid it reveals that the foundry, however well founded, has not stood the strain and stress of modern industrial depressions. Still, for sylvan surroundings and airy working

George Washington's Foundry.

conditions the building seems to be well in advance of even the most modern standards of industrial welfare. As a biased Englishman, I cannot help feeling that the General would have been well advised to have remained an honest, peaceful foundryman, dreamily turning out perfect castings in idyllic scenery instead of interfering with high politics. Had he stuck to his last the Washington foundry would have looked more prosperous to-day, instead of being an object lesson to all foundrymen who want to start a war. Moreover, the whole of North America would be in the British Empire, which, although Mr. Sillers might disagree with me, might be a Good Thing. On the other hand, of course, our statesmen were such chumps that they probably would have lost the U.S.A. anyway.

I would have liked an interview with the First President about his foundry. What I want to know is whether he took up politics because foundry work left him so much spare time, or whether he dived into the War of Independence as a relief from the hectic life of the foundry.

There is always the possibility, of course, that he started the foundry *after* the war. It would be pleasant to think that G. W., after winning a war and founding a nation, looked around for fresh fields to conquer, picking on foundry work as that most suited to his mettle. Imagine him saying "Well, when all's said and done, there's not much difference between winning a war and making a really good casting." "Marksman."

London Foundrymen's Annual Meeting

SHORT PAPER COMPETITION

The annual general meeting of the London Branch of the Institute of British Foundrymen was held at the Charing Cross Hotel, London, W.C.2, on Wednesday, April 4, 1934, with the Branch-President (Mr. C. H. Kain) in the chair.

The minutes of the preceding annual general meeting were taken as read and were confirmed and signed.

Hon. Secretary's Report

The report of the hon. secretary (Mr. H. W. Lockwood) on the work of the Branch during the session 1933-34 was as follows:—

Mr. Chairman and Gentlemen,—As a result of a referendum carried out before the commencement of the session it was decided to hold our meetings on Wednesday evenings instead of Thursdays as previously. The result has been a distinct success and the average attendance at meetings has been well above those of previous years.

The lectures which have been given were of a high standard throughout, and one by Mr. R. G. Russell was unique in so far as it was the first occasion a dominion foundry owner had contributed to the Proceedings of the London Branch, or indeed of the Institute. In December we were the guests of the Institute of Metals at a joint meeting, when Mr. J. R. Handforth, M.Sc., delivered a most interesting Paper on "Developments in Foundry Practice." In January we were the guests at a similar meeting with the Electrodepositors' Technical Society. Two Papers were presented, one dealing with the manufacture of castings for plating, and the other dealt with the plating of castings. The former was given by one of our past-presidents, Mr. G. C. Pierce.

Endeavours are being made to extend the scope of joint meetings with other technical bodies, and it is hoped that two or three such meetings will take place annually in future.

The number of new members enrolled during the year is 32 as compared with 23 during the previous session. A large proportion of this increase is due to enrolments made at the Institute of British Foundrymen's stand at the Foundry Trades' Exhibition held in May last.

The total strength of the Branch is 228 as against 208 last year. This number is made up as follows:—Subscribing firms, 6; members, 139; associate members, 76; and associates, 7.

The annual dinner held in December was one of the best in the history of the Branch. Actually 114 members and their friends attended, and Viscount Lymington was the principal guest.

The financial state of the Branch continues to improve and expenditure has been reduced to the minimum. Overdue subscriptions are much less than they were 12 months ago, and it can fairly be said that the financial condition of the Branch is better than it has been for some years past.

May I conclude by expressing to you, Mr. Chairman, the councillors and all members of the Branch my deep appreciation of your kindly co-operation, which has made my office, which could be an onerous duty, a pleasurable occupation.

The report was unanimously adopted, and the members of the Branch expressed their gratitude to Mr. Lockwood for his services as hon. secretary during the past year.

Officers for the Year 1934-35

In accordance with the Council's recommendations, the following were elected to serve for the ensuing year:—Branch-President, Mr. A. S. Beech; Branch Senior Vice-President, Mr. F. O. Blackwell; Branch Junior Vice-President, Mr. V. Delport.

Members of Council, etc.

The members of the Council who retired by rotation were Mr. A. C. Turner, Mr. F. J. Wares and Mr. J. D. Hotchkiss, of whom Mr. Turner and Mr. Wares offered themselves for re-election. Owing to the fact that in 1932 only two councillors instead of three were elected, it was necessary on this occasion to elect four, one of whom should serve for only one year, the remaining three to serve for the normal period of three years. Mr. Turner suggested that if he were re-elected he should serve for only one year. Therefore, councillors were elected as follow:—

Mr. A. C. Turner (for one year).
Mr. F. J. Wares (for three years).
Mr. B. B. Kent (for three years).
Mr. R. B. Templeton (for three years).

Mr. H. W. Lockwood was unanimously re-elected hon. secretary.

Proposing a vote of thanks to Mr. Lockwood, the Branch-President said that only those who had served as Branch-President during Mr. Lockwood's period of office as hon. secretary could appreciate fully the enormous amount of work he had done on behalf of the Branch, and the remarkably efficient manner in which he conducted its affairs.

Mr. J. W. Gardom (Past-Branch-President), seconding, also commented upon Mr. Lockwood's efficiency; the members of the Branch, he said, were grateful to him for continuing to serve as hon. secretary and for his constant endeavour to make the work of the Branch even more successful than he had made it already.

The vote of thanks was accorded with acclamation.

Mr. Lockwood, in a brief response, assured the members that his work was a pleasure by reason of the co-operation of the Branch-President and councillors and the members as a whole.

Mr. A. R. Bartlett and Mr. C. Cleaver were re-elected hon. auditors.

Mr. F. J. Wares, Mr. F. J. Cree, Mr. A. W. G. Bagshawe and Mr. A. C. Turner were re-elected Branch delegates to the General Council of the Institute.

Mr. Wesley Lambert was re-elected and Mr. C. H. Kain was elected to represent the Branch on the Institute's Technical Committee. (Mr. Kain was elected to fill the vacancy in the representation of the Branch due to the fact that Mr. J. W. Gardom, who was formerly a representative of the Branch, has transferred to the Birmingham Branch. Mr. Kain, however, has been a co-opted member of the Technical Committee almost from its inception.)

This concluded the business of the annual general meeting.

Short Paper Competition

Following the annual general meeting, a short Paper competition was conducted. Five Papers were submitted, on the following subjects:—

(1) The Mechanised Foundry.
(2) Coke and Diamonds.
(3) The Manufacture of Nickel-Iron Alloys and their Relation to Modern Industry.
(4) The Future of Cast Iron.
(5) Foundry Outlook.

The names of the authors were not disclosed until the competition was concluded. All the Papers were read by Dr. A. B. Everest, and subsequently the members recorded their choice of the best Paper by means of a ballot. "The Future of Cast Iron" was adjudged the best. It was then disclosed that the author was Mr. L. B. Hunt, to whom a small prize was awarded. The meeting accorded hearty thanks to Dr. Everest for having read the Papers.

The Future of Cast Iron*

By L. B. Hunt, A.R.C.S., M.Sc.

Recent advances in the metallurgy of cast iron have probably exceeded in importance those in the metallurgy of any other class of engineering materials, and it is interesting in the light of the rapid developments which have been made to look forward to the part likely to be played by cast iron in the future of engineering. The trends in engineering practice are in general towards the more rapid and economical production of lighter and more highly-stressed machines in larger quantities, as exemplified by the automobile industry. The latter industry is constantly increasing its demand for cast iron for structural purposes, and it may safely be said that considerable interest will be taken in the development of stronger, sounder and more uniformly consistent castings, capable of withstanding more or less severe stresses, and of being used in sections appreciably thinner than those ruling at present. The advances which have been made in special irons for such purposes as resistance to heat and corrosion, and in heat-treated alloy irons, are well known, and will not be further discussed, in the belief that the main avenue of advance in the immediate future lies in the improvement of commercial structural castings to a standard of strength and reliability well ahead of that now obtainable.

Initial Advantages

Looking more closely into the factors involved in this development, it will be seen that cast iron possesses initial advantages on the score of low-cost and rapid-production methods, but disadvantages where weight and resistance to stresses are concerned. Clearly, then, the employment of cast iron in the changing conditions of the future will depend upon the advances made under the two latter heads. Weight, or at least specific gravity, is unalterable, but taking the two factors together it may be predicted that considerable advances will be made in the structure and properties of cast iron and thence in its employment in lighter sections and for more highly-stressed components. The question of reduction of sections is, of course, bound up with foundry technique, but on the other hand cast iron possesses one further natural advantage over the rival light alloys which is often forgotten—namely, its comparatively high modulus of elasticity. It would seem that Nature is always laughing up her sleeve at the attempts to produce lighter and still lighter alloys for high-duty purposes, since it is always found that the lighter the metal the lower is its elastic modulus. This factor governs the rigidity obtainable from a given section, and thus serves, in the case of cast iron, to mitigate to some extent the advantage of low specific gravity possessed by the aluminium and magnesium alloys. In the author's view then, further advances in the employment of cast iron will be dependent firstly upon improvements in structure, and secondly upon the more enlightened design and application of castings, based upon a better understanding of the properties of cast iron.

Directions for Improvement

Improvements in structure will naturally be dependent upon (*a*) composition, (*b*) melting conditions, and (*c*) cooling conditions. The objective is the production of uniform pearlite, as free as possible from discontinuities, having the graphite in much finer flakes, and with as low a phosphorus content as possible. There is a marked tendency at the present time to the reduction of total carbon, phosphorus and sulphur contents, and although certain arguments have been advanced against these reductions, it is now reasonably established that there are definite advantages to be gained by the restriction of these constituents to a minimum. More particularly is this the case with the phosphorus

* The Winning Paper submitted for the Competition.

content, which will certainly arouse more attention as the matrix of the alloys is improved in the direction of uniformity and ductility. The interruption of the matrix by the hard and brittle phosphide eutectic is a potent cause of brittleness, and markedly reduces the fatigue strength. The uses of nickel and chromium are now too well known to need description, and much may be expected of the alloy irons in the future. For example, the most recent developments in the use of cast iron, for automobile camshafts and crankshafts, are dependent upon the use of a nickel-chromium-molybdenum iron of very high strength properties. On the other hand, the straight silicon irons seem to be quite capable of development for many structural purposes, and whilst the use of molybdenum, vanadium and titanium for the purpose of grain refinement is slowly spreading, here again there would appear to be no real obstacle to the production of straight irons with equivalent structure and properties, provided the cooling conditions were under careful control.

The Germ Theory

With regard to melting conditions, the germ theory and the effects of superheating and inoculation are now generally understood, and the author is of the opinion that in the near future research on the mechanism of graphitisation will lead to the production of a uniform, wholly pearlitic structure, having graphite flakes very much finer than are now produced, somewhat analogous to the ferrite-fine-graphite structure of "Silal." Such a structure would give an iron of high-strength properties and capable of appreciable plastic deformation.

Further, the melting of the charge out of contact with the fuel and products of combustion, as in the electric furnace, is a development which is sooner or later inevitable on logical grounds. The chief desideratum in connection with the cooling conditions is more accurate and more widespread control. Pyrometric control of pouring temperatures is vital to the consistent production of sound castings of high-strength properties, and must be developed and intensified in the future, whilst the advances in sand control will also constitute an important factor here.

Cast-Iron Crankshafts

The fundamental properties of cast iron have been little understood until quite recently, and are still the subject of much misinterpretation by the engineer. Cast iron is now known to possess a clearly-defined fatigue strength, and a high ratio of fatigue strength to tensile strength, and is also comparatively insensitive to stress-concentration effects. It was this latter property, for instance, which accounted for the successful trial of a cast-iron automobile crankshaft under conditions of eccentricity which caused the premature failure of a forged-steel shaft. Bound up with this property of surface insensitivity is the property known as damping, which has only recently been investigated. Materials possessing high damping capacities are able to be deformed under repetitions of stress to a higher degree than Hooke's law predicts without being damaged. In this respect cast iron is greatly superior to the light non-ferrous alloys, which are markedly susceptible to surface defects and changes of section. Cast iron is, in fact, much less sensitive to the effect of notches, holes and changes of section than is steel and other ductile materials, and its fatigue strength is thus not appreciably reduced by such sources of stress concentration.

The author is convinced that advances on the lines indicated in this brief and possibly conservative forecast will be made without undue delay, and that in this way cast iron will not only keep pace with developments in engineering practice, but will also regain some of the ground previously lost to the light alloys, and to welded structures, which, after all, consist in part of extremely bad castings.

The Mechanised Foundry

By J. W. Gardom

Many articles and Papers have been written on the subject of mechanisation in the foundry, but as a general rule have been written with a view to suggesting the best methods of mechanisation. That is, authors have generally described the various types of elevators and conveyors most suitable for handling the sand and moulds for different classes of work. Such Papers have not been helpful to the busy foundryman in assisting him to obtain a true picture of the advantages of mechanical-handling methods or of the changes which would be necessary in his ordinary practice if mechanical handling were adopted.

The question as to the most suitable type of conveyor, whether scraper, belt or bucket type, can well be left to or discussed with the conveyor makers, who have experience of handling such widely differing goods as barrels, bulk articles, sugar, cement and household refuse, the latter in London alone amounting to 2 million tons per annum. It is emphasised that the installation should be flexible.

Elasticity—A Basic Principle

Often the price of the original lay-out is cut and allows only for a minimum plant to obtain a maximum output of the type of castings being produced at the time of the installation; then, at a later date, when a change in production is desired because of some alterations in the design of the castings or other cause, the mechanism installed does not lend itself to the change. In such cases a consultation with specialists in mechanical handling in the first instance, and a possible increase in the total cost of only 10 per cent. would have avoided the failure of the system to accommodate changes.

The Case of the Automobile Industry

The motor-car industry each year has to take care of changes of design to such an extent that machine and assembly shops are completely reorganised, batches of single-purpose machines being changed to new and remote positions, yet the handling system in this, the most conveyorised section of industry, is capable of dealing with an even flow of work after each yearly upheaval. Casual observers are often heard suggesting that articles are being taken for a joy-ride, or that certain operations are being carried out twice. No one can, however, truthfully say that the up-to-date, fully-mechanised motor-car factory

(1) increases the labour of the productive workers; (2) finds less employment over previous methods; (3) does not give value for money, and (4) does not produce a profit on the capital expenditure.

The Loose-Pattern Foundry

In the hand foundry, however, as a general rule the management depends upon its skilled workers to produce good-quality castings by time-honoured day-work methods, improvement or perfection in any one type of casting being built up by a study of the worker's failures. This cannot be done in the mechanical foundry, where even the smallest operation must be carefully considered beforehand and every possible contingency of failure guarded against before commencing production, so that high-quality castings may be produced first and every time. This means work, real hard work, for the executive, and it is here, and only here amongst the organiser and directional staff of a correctly-run mechanical foundry, that the jibe that mechanical foundries produce sweated labour can have justification. The sweating, however, is of the "head" or "riser" and not of the "body" or "casting."

The ideal of the manager of a mechanically-equipped foundry is to produce good-quality castings on quantity lines at a profit and to carry out this programme so efficiently that the workers may be paid at higher rates for a lower expenditure of physical labour in shorter hours.

Sand Practice

The necessary change in sand practice is perhaps the greatest difficulty to be overcome in changing over to a mechanical plant. The sand system should be planned to handle at least 50 per cent. more than the quantity which it is estimated will be sufficient. Arrangements should be made for spare moulding machines and machine stations, so that experimental work on new patterns can be carried out without interference with ordinary production. The sand hoppers can be so arranged that they may easily be removed to new positions and altered to suit improved or different types of moulding machines that may be required at a later date.

The moulding machines chosen should be of robust construction and they should be worked full out. The majority of machines in hand foundries are only worked 50 per cent. or less of the time. The sand itself will necessarily be in a different condition in a mechanised plant. Facing sand should be eliminated if possible, but if facing sand has been in use before the change over it should be retained for a time, and the quality of the bulk sand gradually brought up to requirements so that the facing sand may be dispensed with.

The sand is quickly returned to the moulding positions after the moulds are cast, and towards the end of the day may become quite hot. In the writer's experience this is no disadvantage, and sand has been satisfactorily used when fed from the hoppers at 70 deg. C. When there is a big difference in temperature between the sand and pattern, however, the surface tension between pattern and sand will be increased, and it is necessary to heat the pattern to somewhere near the sand temperature or spray the pattern plates with suitable solution to avoid trouble due to bad lifts.

Influence of Knock-out

In a mechanical plant the castings are usually knocked out as soon as they have solidified, and this has an influence on the condition of the sand. In the first place, the sand near the surface of the casting will be exposed to the action of the air when red hot, causing more of the coal dust in the sand to be oxidised. Also, it allows an oxidising atmosphere to come in contact with the casting when hot, whereas when the mould remains closed until the casting is cold it does so in a reducing atmosphere, there being insufficient air to oxidise all the surface coal dust. The finish of the casting in the mechanical foundry is not, therefore, so good, and to counteract this it is necessary to pay particular attention to the grading and quality of the coal dust added and also control the grain size of the sand in contact with the casting. Secondly, the castings are usually knocked out on a vibrating screen, which will remove more of the sand which has been in contact with the metal. This means that a certain amount of burnt sand is continually being taken into the sand system. If a moulding sand is heated to a neighbourhood of 600 deg. C. the clay-bond loses its combined water and becomes useless. This combined water cannot be replaced by artificial means, and the sand therefore slowly becomes deficient in bond.

The dehydrated clay, together with the fine sand particles which have been broken up by heat also have another effect. It is often stated that this material, which is known as silt, closes up the air spaces between the sand grains and causes the sand to become impermeable to gases. It is suggested here, however, that the presence of this fine material does not itself reduce the permeability of the sand seriously, but because it necessitates the use of more moisture to get a proper distribution of the bond the permeability "value" falls. As a general rule the larger amount of fine material in the sand the

greater amount of moisture is required to give satisfactory lifting properties, and therefore the lower the permeability. Several well-known British moulding sands contain, as purchased, over 25 per cent. "silt." This material is defined by Prof. Boswell as being composed of particles greater than 0.01 and less than 0.1 mm. in dia. These sands give satisfactory results in the hand foundry, but only by lavish applications of the moulder's art, such as handfuls of specially-prepared sands here and there, applications of the water brush, patching and then venting, venting, venting.

Colloidal Clay Bonds

This want of permeability is counteracted very skilfully by means of mechanical venting. In mechanised-moulding systems, however, time cannot be allowed for these unproductive operations, and the use of "silt"-bearing fine sands must be avoided. In the foundry the silt or fines are gradually built up mainly at the expense of the clay-grade, causing larger amounts of moisture to be necessary in order to ensure a proper distribution of the remaining clay bond.

In the mechanised foundry, where control of the sand is necessary in order to ensure the production of high-quality castings, free from internal and external defects, some means of making good the bond which is continually being lost should be arranged. This may easily be accomplished by additions of colloidal material, and as these additions allow of less moisture being used while allowing a good strength to be developed by the sand, the permeability of the sand will remain well above the point at which trouble may arise, even after being in circulation for lengthy periods.

Sand-testing equipment is a good investment in any foundry, but in a mechanical plant it is essential. Time will not permit of discussion of the effect of the shorter cooling time, the necessary improvement in pattern equipment, the control of molten metal to meet new conditions or the planning of operations and maintenance of equipment. The wise foundryman can, however, learn much from the engineer in cutting out unproductive operations.

"Coke and Diamonds"

By A. B. Everest, Ph.D.

After iron in its various forms, as pig-iron, steel scrap and ferro-alloys, carbon is undoubtedly the next most important material consumed in the iron foundry. Whilst pig-iron and cast iron receive the major attention of authors belonging to the Institute, however, only relatively minor attention has been given to the various forms of carbon on which the successful operation of the ironfoundry depends. Undoubtedly the most important application of carbon in the foundry is in its use in quantity as a source of heat in the cupola. Foundrymen in the past have, of course, realised that the use of good-quality coke pays, since it results in the first place in lower sulphur pick-up and also in less wear and tear on the furnace due to its low sulphur and ash content, the former being absorbed by the iron whilst the latter requires extra limestone to slag it off. Beyond these factors detailed attention has not been extensively given. Some attention has been focused on the physical properties of coke in relationship to the working efficiency of blast furnaces, but now foundrymen are turning with more interest to such questions as carbon pick-up in the cupola which are undoubtedly affected by the general mechanical quality of the coke and its chemical reactivity. It is hoped that, during the next two or three years, a great deal more will be heard on this point.

Coke

Coke is, of course, also used extensively in the foundry as fuel for core stoves, mould dryers and, in fact, for all purposes where a convenient source of heat is required. Whilst carbon in other forms is used as coal dust and as plumbago in sand mixtures, mould dressings and the like, mention must, of course, also be made of the graphite in pencils used for writing records, reports and complaints to the management.

The bulk of this carbon consumed in the foundry is ultimately burnt to carbon dioxide and passed into the atmosphere. It is interesting, however, to remember that a very appreciable quantity of it is sold again by the foundry in cast iron, approximately 1 ton of carbon being delivered with every 30 tons of average castings.

The carbon present in the castings is, of course, partly in the combined state but, in grey iron, the bulk of it is in the form of graphite flakes. Many Papers given recently lay stress on the fact that the carbon in the iron is unquestionably the controlling element in determining the physical properties of the metal—thus coarse, bulky graphite flakes are generally associated with a relatively poor iron of about 10 tons per sq. in. strength, whilst with semi-steel irons containing the graphite in smaller quantity and in a more dispersed form, the strengths progressively increase until, with the new special irons, phenomenally high figures are reputed to be attained.

Romance of Carbon

Behind all these various forms of carbon there is, however, a great deal of romance, and it is interesting to stop for a moment in the midst of daily routine and to give a thought to the steps in the continual evolution of carbon for which founders must accept responsibility. It is well known that coal is the product of prolonged high-pressure carbonisation of vegetable matter and that the coal brought up from the mines actually represents plants which lived in primeval forests hundreds of years ago, so that the actual particles of coal dust used in the foundry are in reality stems, leaves and flowers of these prehistoric plants.

Since coal contains, however, in addition to carbon, a certain amount of oily matter in the form of hydrocarbons and frequently proportions of rocks and earth, its nature does not make it suitable for use as a fuel in melting furnaces, and, consequently, the coal must be specially prepared. It is treated in the first place by crushing and washing, whereby some of the earthy and rocky matter is removed, and subsequently it is given a low-temperature heat-treatment to drive off moisture and the volatile hydrocarbons. Coke is the result of this process, and, according to the manner in which it is made, combines the necessary properties of hardness and mechanical strength, together with the reactivity required in the foundry.

Action of Coke

In coke, however, there is a purely artificial material, its structure is cellular, the actual form of the carbon being amorphous, that is to say, non-crystalline. In melting the iron in the cupola some carbon is picked up—in fact, the whole carbon content of an iron casting has been picked up from coke, either in the blast furnace or in the cupola. The carbon is dissolved in the molten iron, but, as the solubility of carbon in iron decreases as temperature falls (largely owing to the presence of other elements such as silicon), carbon is precipitated in the metal in the form of the graphite flakes which everybody knows so well. These graphite flakes, however, although carbon, now have a different form in that they are composed of minute crystals of carbon, whereas previously the forms of carbon which have been dealt with have all been non-crystalline.

This leads us to another interesting thought. Since carbon is known to crystallise in a variety of manners and one of these crystalline forms is the diamond, the latter so highly prized on account of its beauty and rarity is, in fact, very closely related indeed to all the forms of carbon which are handled every day in vast quantities in industrial plants. In fact, diamonds would make an admirable fuel for use in cupolas.

Moissan's Experiments

This close relationship between graphite in iron castings and diamonds was admirably demonstrated by Moissan in 1905, who used the solubility of carbon in iron as the basis for his experiments. Moissan used a mixture of pure iron and carbon melted to a temperature of 4,000 deg. C. in an electric arc furnace; after which the crucible full of metal was quenched out in water. The sudden contraction of the skin of the ingot on to the still molten core exerted a tremendous pressure, so that the excess carbon present was thrown out from the iron under enormous stress. When the cold ingot of iron was dissolved in acid the residue contained a large number of small particles, which, on subsequent examination, proved to be nothing more nor less than real diamonds. It is thus seen that every iron foundry is, in fact, a potential diamond factory; but the author wishes to make no claim to royalties from any foundry which is successful in following up this idea.

It was mentioned above that the bulk of the carbon used in the iron foundry is passed out into the air as carbon dioxide. This carbon dioxide is, of course, joined by similar products of combustion from many other physical and chemical processes, including even the discharge of breath from human bodies in which vitality is maintained once again by the slow combustion of carbon and its compounds. The completion of the cycle is effected when the plants and vegetation of the countryside re-absorb the carbon dioxide and split it up again under the action of the sun's rays, returning the oxygen to the air and converting the carbon into hydrocarbons in the structure of the plant itself. Thus the coke burnt in the foundry to-day will, in a short time, form part of some tree or other plant in the country, which, in process of time, will die down and become buried in the earth, only to yield coal again for the use of a foundryman working in iron, gold or platinum, as you like, in a few thousand years' time.

Foundry Outlook

By C. Howe.

The present-day demands from the foundry are far greater than they were a few years ago. The users of castings are constantly on the look-out for stronger, lighter and more reliable materials; in the old days the weight of the casting was not a matter of great moment, therefore the designer could make the section of his casting thick enough to allow a reserve of strength in case of hidden flaws. Nowadays that is all changed, for owing to the differing requirements of modern manufacturers, every casting must be perfect and no hidden defects can be allowed for. In the first place this is owing to increased competition, and secondly to the improvement in motor, aero-engine and machine design.

Effects of Modern Competition

Dealing with competition first, it is seen that castings are usually sold by weight, consequently the designer who is able to reduce the thickness of his castings to the minimum compatible with safety is likely to undercut his competitors and find a successful market for his goods. Weight also counts in aero construction, and it was soon found that to obtain efficiency it was impossible to make sections in any casting thicker than definitely necessary. As the designers had not enough confidence in castings to reduce the thickness of the metal, the castings were gradually superseded by stampings, forgings and fabricated parts. This is not the only direction in which the demand for founders' products has diminished, but these specific cases will serve to

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illustrate the point. It cannot be said that the change in every instance tended toward cheapening the article, but it was more than justified by the reduction in weight and the greater reliability thus obtained. It is quite possible that in many cases the result of these changes has been so successful that the use of castings will never more be reverted to, and so good trade has been lost to the foundry for ever.

Why is this? The casting has come to be regarded as an unreliable article, full of hidden defects which oftentime become apparent only in service—so much so that they can only be used when an ample margin of safety is allowed.

Recent Progress

In the face of this what has been done by those who are controlling the destiny of the foundry? Are they content to sit and watch their business being taken over by others? The answer is in the negative, as it is safe to assert that of recent years amazing strides have been made by metallurgists and founders. Not only have they stopped the decay in the industry, but are now regaining lost ground and are actually entering into competition with their rivals. This progress has not been revolutionary, but so gradual that from year to year but little headway seems to have been made, and it is not until present-day practice is compared with that of a generation ago that one realises how much increased are the demands now made of the average foundryman.

Great Britain was one of the first countries to exploit cast iron for commercial purposes, and with the extended use of this metal the prosperity and power of the country increased. Is it not significant that when the production of iron was at its peak this country was at its zenith and as the production of iron decreased, so did the fortunes of the country decrease with it. Let us hope that now the tide has turned and cast iron in an improved form is regaining lost ground and finding new applications, so may Britain with it rise again to her place as leader amongst the nations. Girders, bridges, bedplates and all manner of similar castings were once made of cast iron, but now serious inroads upon the trade are made by wrought iron, steel and even cement, because these materials are considerable more reliable, and in some instances cheaper than cast iron.

Gain in Average Mechanical Strength

The average tensile strength of cast iron was formerly about 9 tons per sq. in. with a transverse of 26 cwts., but now we hear of firms producing regularly irons giving over 20 tons tensile with 40 to 45 cwts. transverse. Do designers avail themselves of this improvement? Apparently not always, for there are still text books that advocate the same factor of safety as was used years ago. This, of course, should not be so. Full advantage should be taken of the improved strength of cast iron. If castings are obtained from reputable firms, engineers and draughtsmen can rely upon the materials supplied them being up to standard; they can then without risk increase their factor of safety as allowed by the strength of the iron and design their castings accordingly.

It is not only in strength that cast iron has been improved; advances have been made in other directions. Even the Cinderella of the Cinderella trade has come under consideration—namely, the firebar. The firebar was once a despised article, a poor class of labour was employed in its manufacture and any type of iron was used for casting, owing, no doubt, to the very low prices then obtaining. But times change. Following the use of mechanical stokers, it has become an expensive proposition to renew the grates, therefore there has arisen a demand for a better class of firebar with greater heat-resisting properties. This has been met, and irons with three or four times the normal life of the old article are being regularly produced. From the chemical industry has come a call for an iron capable of resisting corrosion by acids. After some research this has also been successfully produced, and there are now foundries which specialise in producing this class of iron.

These improvements have been brought about very largely by refining existing brands of pig-iron or by the introduction of varying percentages of such metals as nickel, chromium, copper, and even at times of the rarer metals. Many foundries specialise in the manufacture of these new irons, so that engineers should have no difficulty in finding an alloy to meet any specific need.

Non-Ferrous Developments

Turning to the non-ferrous alloys, I think it safe to assert that even greater progress has been made in this direction. No greater physical tests are now called for from the old alloys of gunmetal, brass, etc., but it is in the more complete alloys that the greatest advances have been made. In the special alloys of manganese bronze and aluminium bronze, tensile tests up to 50 tons per sq. in. in the cast state are being regularly obtained with correspondingly good elongation. Some of these alloys resist the corrosive action of sea water and acids to a marked degree, and consequently are used when great strength is required and steel is unsuitable because acids and sea water corrode it. Because these complex alloys are rather difficult to work in the foundry, quite a number of firms prefer not to use them, but those who have persevered and mastered the difficulties are now producing castings with no greater trouble than that experienced in an ordinary non-ferrous foundry.

The Case of Aluminium

Then, again, the economical production of aluminium has opened a new vista of prosperity and new outlet for trade in the foundry world, and each year sees an increase in the world's production of aluminium castings. These castings are finding new applications daily, and no one can foresee their ultimate possibilities. Unalloyed aluminium is rarely used for castings owing to its lack of strength, but used with other metals it gives an alloy strong, yet light, in proportion to its strength. Aluminium made possible the aeroplane and dirigible, for without it it would have been almost impossible to have produced the reduction in weight per horse-power so essential to aero engines.

The foregoing will show that the foundry trade as a whole is capable of keeping abreast of the times, and provided that the engineer and designer make known their requirements, foundrymen will get down to it and produce the metal, if it is within the realm of possibility.

Pressure-Resisting Alloys

Some mention should be made of alloys for withstanding high pressure. Foundrymen and those connected with the foundry know that large numbers of apparently good castings are lost because they leak when subjected to a pressure test. Here is scope for a great deal of research work; there is no reason why the large number of alloys now in existence should not be reduced to a small number of standard easy-casting alloys suitable for the generality of business purposes. Every alloy is not suitable for the manufacture of pressure castings, and the longer one is in the foundry the more one realises the number of alloys that are notoriously bad in this respect. In spite of this, customers specify that certain alloys are to be used in their castings, and the foundry has to make the best of a bad job, knowing all the time that a slight alteration in composition would make all the difference between the production of a sound and leaky casting.

Here lies a fresh task for the founder, namely, to produce a range of easily-cast pressure-resistent alloys, giving physical characteristics comparable to the alloys already in use, and then to educate the engineer and designer in their use.

Notes on the Manufacture of Nickel-Iron Alloys and Their Relation to Modern Industry

By G. R. Webster, A.M.I.Mar.E., Assoc.I.E.E.

For the purposes of this short Paper the various alloys may best be considered by grouping them under four headings, namely: (*a*) Alloys with up to 40 per cent. nickel, (*b*) alloys with 40 to 46 per cent. nickel, (*c*) alloys with 46 to 60 per cent. nickel and (*d*) alloys with 60 per cent. or more nickel. In group (*a*) the alloys with 30 to 36 per cent. nickel have low coefficients of expansion, but only over certain temperature ranges; a series whose coefficients of expansion vary from practically zero to about 20×10^{-6} per deg. C. comes within this range, the alloy containing 35.6 per cent. nickel has the minimum coefficient.

A 36 per cent. nickel alloy with a small percentage of chromium is used for the springs in timing mechanisms; its elastic properties are not nearly so sensitive to slight variations in composition as the straight nickel-iron alloys. Considerable quantities are used as one part of the bi-metal strip in the construction of thermostats. A nickel content of about 30 per cent. is particularly interesting electrically, for at this point the material is nearly non-magnetic but with a sharp increase in hysteresis loss.

(*b*) Alloys in this range have somewhat lower expansibilities and are used for glass-to-metal joints; they are coated with copper so that the expansion and contraction of the wires are the same as the glass. Perfectly air-tight joints, which are so necessary in electric lamps and radio valves, may thus be obtained.

An alloy of 46 per cent. nickel has a coefficient of expansion equal to that of platinum.

(*c*) Alloys containing 48 to 50 per cent. nickel have coefficients of expansion very similar to that of lead or soda-glass and are used instead of platinum for many glass-to-metal joints. The 50 per cent. material is used quite extensively for the cores of audio-frequency transformers; as they are relatively incorrodible, they are of value under special conditions in the construction of electro-magnetic equipment. The 56 per cent. nickel alloys have the same expansibility as steel, but are more stable and less liable to corrosion. Considerable quantities are used in measuring instruments.

(*d*) Coming in this group are the alloys with very remarkable magnetic properties, containing 80 per cent. nickel with small percentages of other metals such as copper, chromium, manganese, tungsten, etc. The following illustrates these properties in comparison with "silicon iron" which was the "softest" and most "permeable" magnetic material previously known:—

	High Nickel-iron.	Silicon-iron.
Initial permeability ..	20,000	500
Maximum permeability	100,000	1,000
Field μ max.	0.025-0.040 gauss	0.75-1.0 gauss

These very outstanding properties have been utilised in many ways, such as in:—Submarine-cable loading; magnetic shielding; instrument transformers, and to a considerable extent by the radio industry for loud speakers, radio-gramophone pick-ups and microphone transformers.

This group of alloys is susceptible magnetically to mechanical strains. It is necessary for a simple heat-treatment operation to be carried out in the final form, that is, after any stamping or machining. Fig. 1 shows the variation of the magnetic properties with varying percentages of nickel.

Manufacture

These alloys can be forged and worked easily, but are liable to be contaminated by furnace gases with resultant deleterious effect on their mechanical and magnetic properties, if no means

of protection against this is adopted. The removal of minute traces of these elements results in phenomenal properties previously unsuspected. Carbon and sulphur are particularly prone to give rise to instability. The method of melting recommended—the electrical induction furnace—obviates the contamination from fuels or electrodes, and in consequence the alloys are free from those impurities inevitably associated with the older methods of melting.

Considerable success has been obtained in Germany by Dr. Rohn with vacuum melting of metals. The casting of the ingots, as well as the melting, must take place in a vacuum. Advantages of the process show themselves in the working of the alloys; they have a much better ductility, can be worked more easily and with a better yield of finished material. Vacuum melting yields gas-free metals. With proper treatment wires made therefrom should fuse into glass without the formation of bubbles.

Whilst the vacuum-melted products are very definitely of a high quality, they are also more costly in consequence of the difficulty of the

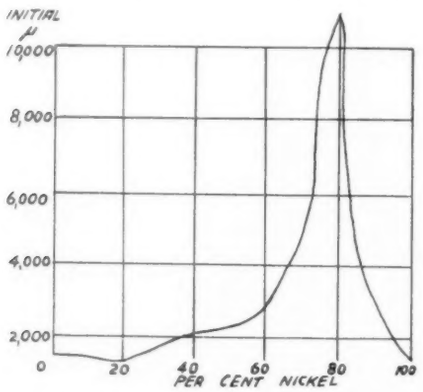

Fig. 1.—Influence of Nickel on Magnetic Properties.

vacuum process. It is necessary to reduce, as far as possible, the cost of total production, the possibility of developing processes and apparatus to give considerable saving in working time, such as a continuous train of hot and cold billet mills, with individual electric drive for each mill to save the high cost of the intermediate anneals.

The processes have worked excellently in the organisation controlled by Dr. Rohn, in continuous operation for a number of years, having reduced the working costs so much that the additional cost due to the complicated and expensive vacuum melting is recovered, so that the final product can be sold for the same price as similar alloys that have been melted and cast at atmospheric pressure by the usual process.

The melts always have a perfectly identical composition and thus always identical mechanical and magnetic properties. It is mostly the requirements of the electrical industry, or a section of it, that have called for these very special metallurgical developments. The metallurgist, with modern technique and facilities at his disposal, has been able to bring about these transformations.

Follsain Patents for Metal Treatment

Follsain Metals, Limited, 62-64, Moorgate, London, E.C.2, have entered into an agreement with the Follsain Syndicate, Limited, and the Wycliffe Foundry Company, Limited, by which they become the sole licensees in the United Kingdom and Northern Ireland for the working of the Follsain patents for the treatment of metals. They are acquiring, on lease, the Follsain section of the Wycliffe Foundry Company's works and are taking over their technical staff. The working of all Follsain Penetral processes will now be carried out by Follsain Metals, Limited. The works are being enlarged and the equipment improved and extended.

The President of the French Foundrymen's Association

At the annual general meeting of the Association Technique de Fonderie, Prof. L. F. C. Girardet was elected as President for the forthcoming session. Prof. Girardet was born on August 7, 1872, at St. Dié, in the Vosges Department, where his father, Mr. Emile Girardet, was a prominent foundry owner, who spent many years of his life at the Marquise Works assisting the famous A. Guettier. This association explains why he was able to perfect the strickle-moulding of gear wheels, which is now common practice. Mr. L. F. C. Girardet was at one time Professor of Chemistry in the Faculty of Pharmacy at Nancy, and during this period he published a number of works dealing with pure, electro and physical chemistry. After the war he left the teaching profession, but nevertheless

Professor L. F. C. Girardet.

published several important books on biological chemistry in collaboration with Prof. Lasseur. However, in 1925, he personally undertook the management of his foundry at St. Dié and immediately introduced scientific control. This brought about a number of researches on cast iron, from the angle of the relationship of structure to mechanical properties and the relationship of moulding methods. Recently, however, he has, in collaboration with Mr. Tsou, studied the corrosion of cast iron and with Mr. Lelièvre the problem of desulphurisation. At the moment he is engaged upon a physico-chemical investigation of foundry sands and has already published some of his results to the Association Technique de Fonderie—a channel he has used for other foundry researches.

Mr. Girardet is a University graduate, receiving the gold medal as well as several silver and bronze ones. In 1932 the A.T.F. honoured him with the award of their first silver medal.

The systematic study of the effects of the stirring up of liquid cast iron from the point of view of structural change in the resultant castings led the newly-elected President to the discovery of "gyratory stirring" and *fonte girée* (churned iron), of which he has made several important practical applications.

The Clay Cross Company, Limited, Derbyshire, is putting down new plant for the manufacture of iron pipes by the centrifugal-spun process.

Newcastle Foundrymen's Plans for Next Session

The annual general meeting of the Newcastle and District Branch of the Institute was held in the Neville Hall, Newcastle-upon-Tyne. On the proposal of the chairman, Mr. J. D. Carmichael, the annual report and balance-sheet were taken as read. Mr. Carmichael also proposed the election of Mr. F. Robson as President for the coming session. The past session had not been altogether rosy, but he thought that he could say with some accuracy that there was some hope for more prosperity in the coming year. It was generally known now that the Council had had a special meeting with the general secretary last month, when the position of the Newcastle Branch was freely discussed. Personally, he was sanguine that some good would come of that. He thought they would help to restore the Branch to something of its former popularity. It was not so much attracting new members that was wanted, as inducing the present members to attend the meetings. There were over 100 members, and the average number who attended meetings was not more than twenty, or thirty at the outside. Before relinquishing the chair, he would appeal to all present to try to attract colleagues to come back to the meetings.

Mr. Scott seconded Mr. Robson's nomination, and he was unanimously elected. Mr. Robson, on taking the chair, thanked the members for his election, and proposed a vote of thanks to Mr. Carmichael and to the other officers of the Branch. Mr. Carmichael, in reply, said that he had tried to do his best, and if his efforts had met with their approval, he was very happy, but he did hope that Mr. Robson would have a better year than he had had.

On the proposal of Mr. Robson, seconded by Mr. J. D. Carmichael, the following officers were elected:—Mr. S. E. Dawson, Senior Vice-President; Mr. C. Gresty, Junior Vice-President; Mr. J. W. Eckford, hon. secretary (re-elected); Mr. J. N. Simm, hon. treasurer (re-elected). Members of Council were elected as follow:—Mr. T. B. McBride, Mr. A. R. Lucas and Mr. W. Redmayne.

Mr. A. Logan was elected and Mr. J. N. Simm re-elected as delegates to the General Council. Mr. Logan and Mr. S. E. Dawson were also re-elected as delegates to the Technical Committee. The appointment of two reception officers was left in the hands of the secretary.

The annual general meeting was followed by an illustrated lantern lecture, entitled "How London's Tube Railways are Made," by kind permission of the London Transport Board.

Foundry Costs-Finding

A lecture on "Foundry Costs" was given by Mr. A. F. Patterson to the Glasgow District of the Institute of Cost and Works Accountants at a meeting held in the Cadora Restaurant on March 14. He pointed out that accurate cost information was undeniably the only true basis upon which to make prices and that the foundryman's most dangerous competitor and the industry's greatest menace was the man who did not know what his different kinds of castings cost him to produce.

Most errors in foundry costs-finding came from using methods which did not truly reflect the amount of work, material, and use of equipment, properly chargeable to different types of castings. It was not enough to charge all the expenses of the business to the product and get it back in the selling price. Correct costing demanded that each type of casting carried only that part of the expenses it involved.

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(*Concluded from page* 250)

ence I have had with Erith and other natural sands, properly blended, does not support all the advantages claimed by Mr. Tait as attending the use of "Synthetic" sands in this country. Moreover, it is, I think, but reasonable to conclude that, if the "obvious" advantages claimed were borne out in practice, "Synthetic" sands would be more generally adopted than they are.

The information given relating to the "liquid flour" with which dried cores are coated in the works Mr. Tait mentions, should prove of benefit to interested readers who, in the absence of any statement to the contrary, may have assumed that it was "cereal flour" that was referred to in the report of my Paper.—Yours, etc.,

R. H. C. Weeks.

3, Brooklyn Road, Wilpshire,
Blackburn, Lancs,
April 13, 1934.

Cupola Practice

To the Editor of The Foundry Trade Journal.

Sir,—I was glad to learn from your editorial note at the end of Mr. Fletcher's letter—published in your issue of April 5—that he is recovering from his illness, and I should like to thank him for the full way he has dealt with some of the points I raised. If I can trespass still further on your space and his time, there are one or two matters arising from his letter on which I should like to comment.

In the first table in his letter, giving an ideal neutral gas, I think Mr. Fletcher has inadvertently put the figures for CO_2 in the CO column, and *vice versa*. If this be so, the table should read:—

CO_2	CO	N_2	Ratio CO_2/CO
Per cent.	Per cent.	Per cent.	
9.4	18.8	71.8 by volume	0.50
14.0	17.8	68.2 by weight	0.78

The percentages of the various hearth gases found in practice with the balance-blast cupola, and given in Table II, differ considerably from the above. I am not quite clear, however, as to what is meant by hearth gases.

Suppose samples are taken in any balanced-blast cupola at a fixed height above the tuyeres, and at a definite radius from the centre of the cupola, for different openings of lower tuyeres. If these tuyeres are restricted in area, less air will flow through them, and the velocity of this air along the gas paths (Fig. 1, my letter 22/3/34) within the cupola will be reduced as compared with conditions when the lower tuyeres are more fully open. That is, the interval of time from entry of air into the cupola, before the resulting gases reach the sampling point, is increased when the lower tuyeres are restricted in area.

Mr. Fletcher tells us—if his hearth gas samples be taken as suggested above—that with this restricted air flow the CO percentage in the gases is increased (para. 5).

This seems to me to indicate that the O_2 of the air on admission burns first to CO_2, and that this reaction and the reaction $CO_2 + C \rightarrow 2CO$ occur relatively slowly under cupola conditions.

Different cokes will react differently, and I agree with Mr. Fletcher that this fact will affect the position of the zone of maximum temperature in a given cupola.

I think, however, that with two cokes of the same calorific value, but with different reactive properties, the correct way to burn both with equal efficiency would be to alter the depth of the coke bed, and also the spaces between the rows of tuyeres. This course is not practical.

An alternative method, and—if the above inference be correct—one almost equally effective, would be to alter the total air supply, while maintaining the ratio between the air supplied to top and bottom tuyeres approximately constant. In my opinion, such a method would be more potent in equalising the efficiencies than a change in the relative air supplies to top and bottom tuyeres, as Mr. Fletcher suggests.

It follows also, in a given cupola, where maximum combustion efficiency is obtained in the hearth, that the rate of heat production and so of melting is dependent on the reactivity (I include combustibility in this term) of the coke, total air supply being, of course, suitably adjusted.

Alternatively, for a given coke, rate of melting can be increased, while maintaining maximum hearth-combustion efficiency, by increasing the spaces between succeeding rows of tuyeres, and the total air supply. Such increase will entail an increase in the average depth of the oxidising zone.

If this analysis of cupola action be true, I suggest that the line of development for making the cupola a melting unit suitable for superheating, even those irons which melt with relative difficulty, is clear.

(1) A coke with a high rate of combustion should be used. Unfortunately—as far as my reading goes—cupola coke has a relatively-slow reaction rate for the change $C + O_2 \rightarrow CO_2$, and a high rate for $CO_2 + C \rightarrow 2CO$.

This means that spacing between rows of tuyeres is very important.

(2) The air supply per unit hearth area should be increased.

(3) Possibly the number of the rows of tuyeres should be increased.

(4) A high-quality lining would be required.

In regard to (1) above, I should like to suggest to the B.C.I.R.A. that a series of relatively-crude full-scale tests of the reaction rates mentioned above, with existing varieties of cupola coke, would provide very valuable results. Possibly here I am knocking at an open door—I have not seen recent publications from the Fuel Research Board.

I am not quite in agreement with the statements made in paragraph 1 (*b*). Over the years, ordinary cupolas have been made for high- and for low-tuyere-air velocities, and with many different proportions between the areas of succeeding rows of tuyeres. Even with a relatively low-tuyere-air velocity, I should not care to assert—from such rough observation as is possible through peepholes—that the maximum rate of melting occurs in an annular zone in the outer half of the cupola. Perhaps Mr. Fletcher has some experimental data to prove his statement.

It is evident from the last table given in the letter that a very high combustion efficiency is obtainable, particularly as changes in the gas composition upwards from the top of the coke bed are apparently negligible.

Again thanking Mr. Fletcher for his letter.—

Yours, etc., F. W. Neville.

Vulcan Works,
Blackfriars Road, Manchester.
April 13, 1934.

Propaganda for High-Duty Cast Iron

To the Editor of The Foundry Trade Journal.

Sir,—Your leader in The Foundry Trade Journal of April 5 deals with a very interesting problem and one which will lead to considerable differences of opinion.

The registration of, and the propaganda connected with, the use of trade names is, I think, the natural outcome of certain ironfounders to get away from the uncertainty, vagueness and variation in characteristics of what is generally known to engineers as cast iron.

Without emphasising the advance which has been made in metallurgy during and since the war, it is an established fact that the nature and extent of the improvements, particularly in cast iron, have not yet filtered through to the designer, who should normally be the first person to take advantage of them, and until the ironfounder gets past the barrier of suspicion and uncertainty which has surrounded his products in the past, so long will the difficulty of getting a fair price for his improved quality remain.

The trade name does offer a chance to get a fair price for what is a better product, inasmuch as it has clearly-defined physical characteristics of tensile, elongation, Brinell, etc., as well as guaranteed properties necessary to withstand heat, abrasion, corrosion, etc.

The desirability of keeping before the engineer the name "cast iron," with its fundamentally excellent properties, is undoubted, and perhaps one method of doing so would be to include the word "iron" in the trade name, which would then become "Ni resist Iron," "Meehanite Iron," etc.—Yours, etc.,

R. B. Templeton.

Ealing Park Foundry, Limited,
Junction Road,
South Ealing, London, W.5.
April 12, 1934.

Manchester Conference

In connection with the annual Conference of the Institute of British Foundrymen, a subscription list has been opened and about £350 is required to cover the expenses. The Lancashire Branch, as host, is entirely responsible for its financing. As visitors are expected to be present from all over the world, it will be appreciated that the cost of entertaining is a serious matter. Subscriptions should be sent to Mr. J. E. Cooke, the honorary conference secretary at 1, Derbyshire Crescent, Stretford, Manchester. Appended is the first list of subscribers.

	£	s.	d.
Messrs. James Durrans & Sons, Limited, Penistone	10	10	0
Messrs. Vickers Armstrongs, Limited, Barrow-in-Furness	10	0	0
Lancashire Branch, Burnley Section	7	0	0
Proprietors of The Foundry Trade Journal	5	5	0
Messrs. Entwistle & Kenyon, Limited, Accrington	5	5	0
Linotype & Machinery, Limited, Broadheath, Manchester	3	3	0
Messrs. Thomas E. Gray & Company, Limited, London, W.C.1.	2	2	0
Mr. F. Hudson, Kilmarnock	2	2	0
The Morgan Crucible Company, Limited, Battersea	2	2	0
Messrs. Hutchinson, Hollingworth & Company, Limited, Dobcross ...	2	2	0
Mr. A. Brownsmith, Manchester ...	1	1	0
Foundry & Engineering Company (West Bromwich), Limited	1	1	0
Mr. W. Gilpin, Manchester	1	1	0
Messrs. Higgin Brothers & Jones, Manchester	1	1	0
I.C.I. (Alkali), Limited, Winnington, Northwich	1	1	0
Mr. A. E. Nayler, Accrington ...	1	1	0
Mr. H. Sberburn, Warrington ...	1	1	0
Messrs. E. Wilson & Company (Collingwood), Limited, Liverpool ...	1	0	0
Mr. A. L. Key, Stockport	0	10	0
Mr. J. Pell, Burnley	0	10	0
Mr. J. A. Reynolds, Prescot	0	10	0
Mr. C. M. Tate, Burnley	0	8	6
Mr. W. Richardson, Cadishead, Manchester	0	5	0
Total	£60	1	6

Road-Sett Foundry of the Stanton Ironworks Company, Limited*

By Percy Fox-Allin (Associate Editor)

The Stanton Ironworks Company, Limited, have recently completed the contract for the cast-iron road setts for flooring the whole of the Mersey tunnel, which called for the production of approximately half-a-million castings. There is no doubt whatever this installation will attract world-wide interest, while if the system proves a success, it will open up a new and extensive field of ironfounding activity.

Recognising that the future of what might well become an important branch of their activities must to a great extent be dependent upon the success or failure of the pioneer installations, the first consideration was the production of a sett which would best meet the peculiar requirements for road work, and it was only after lengthy and costly experiments that a process was evolved for hardening the surface of the studs. The process, which has been patented, is in itself simple, as, indeed, it was essential it should be, to prove of real practical value.

Briefly, it consists of casting the road-sett studs against a special form of metal chill which has previously been treated with sulphur or a sulphur compound. The parts of the mould not to be treated are covered over by a templet, which leaves the chill sections exposed. The sulphur compound is sprayed on to the chill surface by means of compressed air. The templet is removed and the treated chill is then placed in the casting mould, sand is rammed into the mould, which is then assembled ready for casting. This method of production has obvious advantages. It produces a stud which has a very hard outer surface, the metal in the other portion being of close texture, whilst the remainder of the casting is composed of a softer metal. Such a stud is resistant to wear, whereas the more open grain of the remainder of the metal gives strength to the casting and resistance to shock. In the case of castings made in the ordinary way, the stud portions, due to the thicker section, are naturally more open in structure and the wear on them is much greater than with the hard stud.

Having determined the requirements and evolved a system to meet those requirements, it remained to devise a lay-out of plant for the economical application of the system. Any attempt to produce such castings in quantity in the general foundry would have been wholly uneconomic. The Stanton Company made no such mistake; with their usual enterprise they laid off a foundry for the particular production which in its entirety and for its size must rank as one of the best foundries in this country

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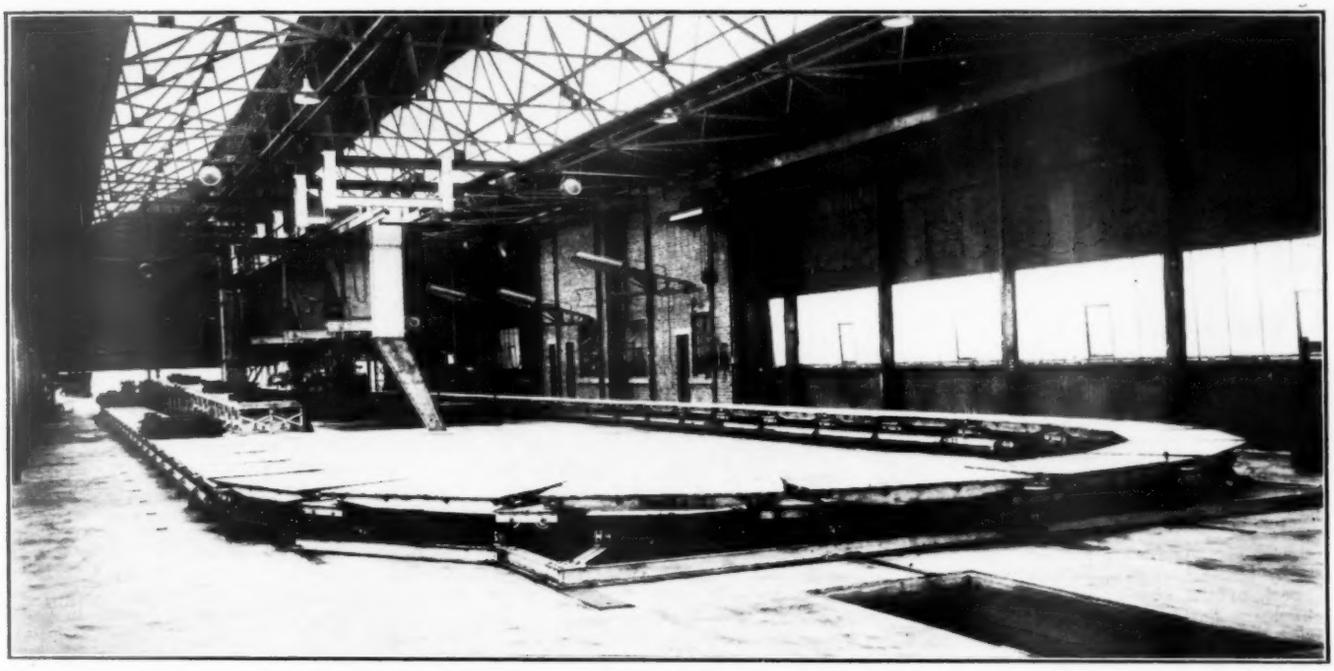


Fig. 1.—General View of Mould Conveyor encircling Moulding Machines.

Fig. 2.—Spraying the Chills with Sulphur.

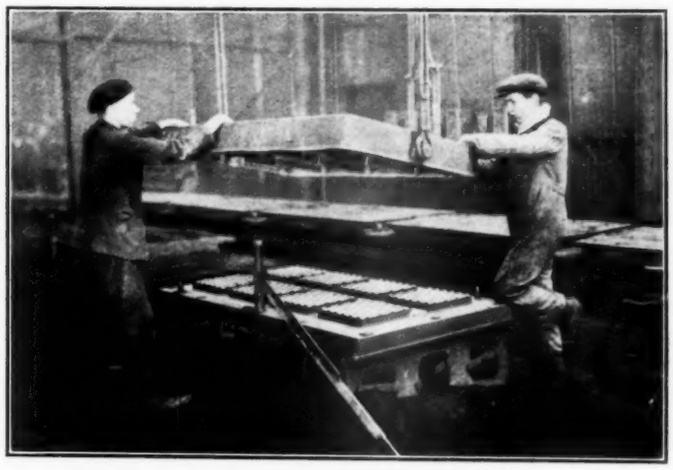


Fig. 3.—Box containing the Chills being Lowered on to Pattern before Ramming.

* See also F.T.J., Sept. 7, 1933.

devoted to the mass production of castings. Mechanisation has been carried out, but not beyond its economic limits. The plant throughout is of a simple and robust character, calling for the minimum of maintenance, whilst the component units are in perfect balance. The foundry building is 390 ft. long by 54 ft. between centres of columns. Fig. 1 shows a general view of foundry floor, mould conveyor and moulding machines. Figs. 2-7 show various stages in the manufacture, including casting arrangements.

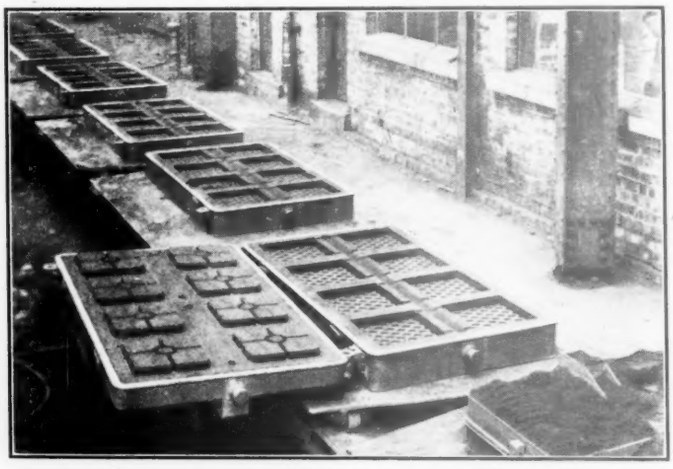


Fig. 4.—Showing Line of Boxes before Closing.

Fig. 5.—View of Casting Arrangements.

Melting Plant and Moulding Machines

There are three cupolas, each of 7 tons melting capacity, blown independently by fans. The hoist and platform are common, and charging is by tipping wagons. The practice is to work each of the cupolas in rotation for the full 24 hrs. Casting is done adjacent to the cupolas, a 4-ton Vaughan casting crane being in service.

The moulding machines occupy a mid-position and are encircled by the mould conveyor, as will be seen from Fig. 1. There are four Jackman stripping machines which are worked in pairs on top and bottom boxes, each pair being served by a sand-slinger. The machines were specially made for the duty and have the following features: The framework carrying the moulding boxes and the inner frame carrying the pattern plate are all adjustable so as to cover a wide range of sizes. The pattern draw is specially arranged to give an extremely slow draw at the instant that the pattern leaves the mould. This draw is oil-controlled, consequently no shock is sustained and the movement is extremely accurate. All moving parts are fully enclosed and guarded. There is a fifth machine which has been reconstructed by the works engineering staff to meet the requirements, and this is served by a separate sand-slinger. At the outset some difficulty was experienced in obtaining a clean draw, which had perforce to consist of a pure lift, tapping being impossible. Iron patterns proved very unsatisfactory, but the brass patterns now employed are in every way satisfactory. Each box provides for 8 setts, each 11¾ in. by 11¾ in. by 1⅞ in. deep with a body ⅝ in. thick, the weight of a sett being 25 lbs.

As already stated, the top and bottom boxes are rammed on separate machines; they are then loaded on to the mould conveyor, which is of the August's double-bogie type, 142 ft. long between centres, with a transverse 37 ft. between centres. The mould-carrying plates are 6 ft. 6 in. long by 4 ft. wide. The net dead weight of this conveyor is 80 tons; its operation is intermittent through the medium of compressed air. The moulds travel completely round, passing in sequence under the casting ladle, to a point for the removal of the scrap, which is loaded on to a conveyor which discharged into a scrap bogie on a line of track outside the foundry building. The moulds and their charge next pass through a cooling tunnel, which is formed above a section of the conveyor, and from which the steam is withdrawn by means of powerful exhausters. After passing through the cooling chamber the top and bottom boxes are transferred to vibratory knockouts, designed and built by the Stanton Company.

From the knockouts the castings are transferred to fettling and cooling conveyors, one on either side of the shop; these are 131 ft. long with a speed of travel of 8 in. per min. After fettling, the castings are transferred from the conveyor to the sand-blast plant, built by Tilghman's Patent Sand Blast Company, Limited; this is of the double rotary-table type, which experience has proved to be eminently suitable for cleaning flat castings, particularly where there is a large surface in proportion to the weight. The machine is of very robust construction. A dust-proof, foot-step ball-bearing supports the table, and this is so arranged that no dust or grit comes in contact with it. The drive to the table is by means of a worm and worm wheel carried in a sealed casing outside the machine. The shot is raised from the hopper, into which it passes through the table, by suction of the exhaust fan, into the settling chamber, passing through a patented sieving and dust remover and automatic self-feeding arrangement into the pressure chamber for re-use. From the sand blast, the castings are returned to the conveyor, which delivers them to the grinders. Of these, there are two surface- and four end-grinding machines. It may be noted that the setts are ground on the bottom as well as the edges. The finished setts are next passed to the inspection table from whence they are loaded by gravity conveyors.

Fig. 6.—Cooling Chills with Water Spray.

Fig. 7.—Finishing Road Setts on Grinding Wheels.

Figs. 8 and 9 illustrate respectively sections through a "Hard-Stud" sett and an ordinary

cast-iron sett, and show very plainly the hard-white outer surface and the denser metal throughout the former compared with the more open metal and absence of hard surface in the latter. Fig. 10 shows comparative structures.

Sand Plant

The sand plant embodies August's automatic system. The reconditioning plant, which

Fig. 8.—Fracture of Sand-Cast Road Sett.

Fig. 9.—Fracture of "Hardsteel" Road Sett.

is housed in an annexe to the foundry, comprises two rotary hoppers, one for the new and one for the used sand. This last hopper receives the sand from the two knock-outs by means of belt conveyors, one for each of the machines. The new sand and the used sand is discharged

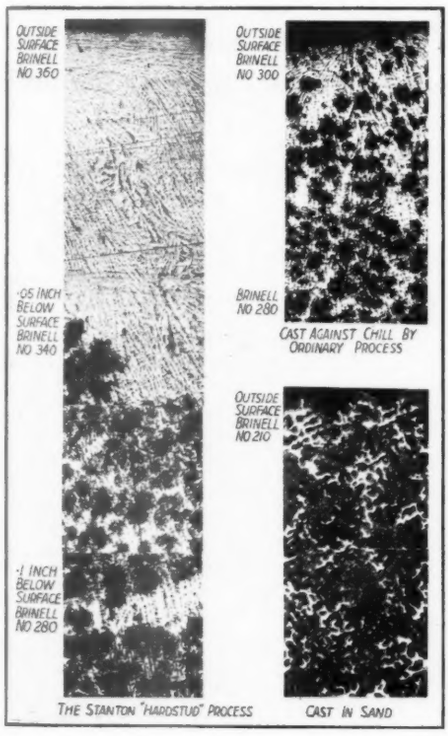

OUTSIDE SURFACE BRINELL NO 360
·05 INCH BELOW SURFACE BRINELL NO 340
·1 INCH BELOW SURFACE BRINELL NO 280
THE STANTON "HARDSTUD" PROCESS
OUTSIDE SURFACE BRINELL NO 300
BRINELL NO 280
CAST AGAINST CHILL BY ORDINARY PROCESS
OUTSIDE SURFACE BRINELL NO 210
CAST IN SAND

Fig. 10.—Showing Structure of Stanton "Hardsteel" Sett, compared with (*a*) Cast Against Chill by Ordinary Process, and (*b*) Cast in Sand. × 100 Dias. (Reduced to ⅓ on reproduction.)

in regulated quantities on to a belt conveyor which feeds the rotary screens; the screened sand passes over a magnetic separator to the boot of an elevator delivering into a 10-ton capacity hopper which is placed over a No. 3 Simpson intensive sand mixer. The sand from the hopper is delivered through an August's air-operated batch measurer into the mixer; synchronised with the measurer are also measurers for water, etc.

The mixer is fitted with two air-operated discharge doors through which the mixed and blended sand is automatically discharged on to a belt conveyor delivering into the boot of an elevator. This discharges through an August's aerator into an 80-ton storage hopper, the aerator serving the dual purpose of aerating the sand and trimming the hopper. The hopper carries a bin discharger which permits of a very wide range over the rate of discharge of the sand on to a belt which feeds the elevator discharging into an August's disintegrator, this last delivering on to a belt conveyor from which the sand is ploughed off at three points to supply the hoppers above the sand-slingers.

The surplus from the overhead distributing belt is released by means of a shute into the spillage belt which runs the length of the moulding shop, collecting from the spillage hoppers beneath the machines and returning same to the sand system. The overhead distributing belt, the disintegrator, the three hoppers and bin dischargers, are all dependent from the roof principals, so that there is no obstruction to the floor space of the foundry. The average daily output of setts, as specified, is approximately 5,000, the maximum output so far obtained for a day of two working shifts being 6,489.

Effect of Arsenic and Antimony upon Cast Iron

The effect of arsenic and antimony contents up to 2 and 1.2 per cent. respectively, upon the strength, structure, growth, and resistance to wear and corrosion of cast iron has been investigated by E. Piwowarsky, J. Vladescu and H. Nipper.* In some irons the sulphur and phosphorus content was varied along with the arsenic.

The degree of graphitisation is not affected by arsenic. Higher sulphur contents retard graphitisation, whereas an effect of phosphorus could not be stated. The form of graphite is not altered, being of the flakey type even with the highest arsenic contents investigated. With increasing sulphur content the graphite flakes form a network extending over the entire section. In most cases the metallic ground-mass is pearlitic, sometimes sorbitic. Occasionally, white patches appear in the structure which, at higher magnifications, can be revealed as extremely fine pearlite. A new constituent was not found.

Influence of Arsenic on Transverse Strength

Up to 1 per cent. arsenic affects the transverse strength only to a slight extent. So, irons with 2.6 to 2.8 per cent. of carbon and low phosphorus and sulphur content showed the following strength figures: 40.8 tons per sq. in. with 0.12 per cent. As, 37.0 tons per sq. in. with 0.22 per cent. As, 34.9 tons per sq. in. with 0.42 per cent. As, 36.0 tons per sq. in. with 1.04 per cent. As, 27.6 tons per sq. in. with 1.27 per cent. As, and 24.8 tons per sq. in. with 1.7 per cent. As. With higher sulphur contents, however, even small amounts of arsenic prove detrimental. On the other hand, the deleterious effect of sulphur or phosphorus is far greater. The deflection decreases with increasing arsenic content, but is more affected by sulphur and phosphorus. The modulus of elasticity slightly increases. This applies also to irons rich in phosphorus and with sulphur contents up to 0.19 per cent. The tensile strength is not affected. With increasing arsenic content the Brinell hardness moderately increases, whereas the impact strength decreases. The latter is, however, more affected by phosphorus and sulphur. The same remarks apply to the repeated-impact strength, which, up to about 1 per cent. of arsenic, shows fairly high values. The wear increases up to 0.32 per cent. of arsenic, and then rapidly decreases. Repeated heating and cooling between 500 and 900 deg. C. under moderate admission of air gave a slight increase in growth with increasing arsenic content. The results, however, are not conclusive because the increase in growth can also be attributed to silicon, the content of which increased along with arsenic. The resistance to the attack by diluted acetic, hydrochloric and sulphuric acid markedly increases with increasing arsenic content. In ammonium sulphate solution corrosion is not affected by arsenic, in molten caustic potash it is somewhat increased. The latter effect, however, must perhaps be attributed to the increasing silicon content.

* Archiv für das Eisenhüttenwesen, 1933/34, No. 5.

Influence of Antimony

With increasing antimony content, the graphite becomes finer. No flakes could be detected in irons containing 1.2 per cent. Sb. The cementite inclusions present in the pearlitic ground mass, when etched with alcoholic sodium picrate solution, show only a yellow tint. This can perhaps be attributed to a solution of antimony in cementite. The transverse strength rapidly decreases even with small antimony additions, the deflection still more rapidly. In consequence, the modulus of elasticity increases. The tensile strength rapidly decreases up to 0.4 per cent. Sb, and then more slowly. The Brinell hardness increases up to about 0.4 per cent. Sb, and then slightly drops. An iron containing only 0.19 per cent. Sb was so brittle that it easily cracked when struck with a wooden hammer. The resistance to wear is considerably increased, the optimum effect being obtained already at 0.2 per cent. The effect upon the corrosion resistance varies with the corrosive medium. The resistance is increased in hydrochloric acid and molten caustic potash, and decreased in acetic and sulphuric acid. In ammonium-sulphate solution corrosion was not affected by antimony.

By melting red iron ore containing arsenic and antimony in graphite crucibles and a baby cupola, pig-irons were obtained containing 20 to 60 per cent. of the arsenic content and 10 to 50 per cent. of the antimony content of the ore. Since the slag contained only little arsenic and antimony, both the elements had been volatilised to a considerable extent. The resulting cast irons showed very poor strength properties, even after being remelted several times, whereby the contents of the two elements were greatly reduced.

Steel Casting in Egypt

According to "Modern Transport," a small "Lift-Out" type of crucible steel melting furnace has recently been installed at the Bulak works of the Egyptian State Railways. This is of particular interest in that no steel casting has ever before been produced on the Egyptian State Railways. The furnace, which was supplied by the Morgan Crucible Company, has a capacity of 320 lbs. of steel at one heat, this quantity being contained in four crucibles, each of 80-lbs. capacity. Primarily, the furnace is used for the casting of such small parts as axlebox keeps, body brackets for coaches, etc., as it is not yet considered advisable to attempt the casting of parts under more stress.

The furnace is fired by coke under forced draft provided by an electrically-driven fan, and the pads are fed with punchings from mild-steel boiler plates and similar material. The degree of elasticity of the castings produced has not, so far, attained the standard obtainable in Europe, but as the only castings produced at present are of a comparatively unstressed type, this is not considered a disadvantage. The furnace has been in use for less than two months, and is being operated by native, and, so far, untrained labour. The average cost of steel castings imported into Egypt amounts to £27 per ton, and the average price obtainable from the sale of mild-steel scrap is £1 16s. per ton, so that locally-produced castings definitely result in economy.

XUM

Foundry Selling Practice

SALES ANALYSIS

By Eric N. Simons

Sales analysis is, of course, a department of market research, or market analysis, but it has the special advantage over the more ambitious and comprehensive scheme in that it is easy and inexpensive to inaugurate, while the results it brings are more immediate and to some extent more tangible. In the present article an attempt is made to describe a system which is, at the moment, being put into operation in a large northern foundry.

The essence of the entire plan is a comprehensive list of users of particular types of castings. Most foundries can furnish you in reasonable time with a complete list of all their customers; but it is another matter when you come to ask them who are their customers for (say) magnet castings, who for stainless castings, who for chrome castings and so forth. Then you frequently find a difficulty. The information is not available in a form in which it can be quickly assimilated. The first step in a sales analysis and promotion scheme is, then, to prepare a classified and comprehensive list of customers for the different types of castings. Furthermore, this list must be kept up to date by continual daily additions.

Recording Orders

The method adopted in the instance under review is that complete lists of all the orders for castings are sent each day to the sales-promotion department. These are gone through, and every new customer for particular castings has a separate card made out for him which is filed in a card cabinet under the heading of the type of castings which he has ordered. Thus, if John Smith has never ordered dynamo castings before, it does not matter that he may have been a regular customer for ordinary castings; down he goes on to a separate card, filed under "Dynamo." The particular type, as distinct from the quality, of casting is specified on the card. Thus, if the classification is by material, as manganese steel or stainless steel, the casting may be a valve, or a cam, or a ring, or all three. The type is jotted down on the card, so that a record is at hand of every type of stainless casting ordered by Brown, or Smith, or Jones. Why this is of value will be explained in a moment.

It is important, for reasons that will be given, to ensure that the absolutely correct name and address appear at the head of each card. Nothing else is required, except, as stated, the type of casting.

Now if there were no further motive in these procedures than the compilation of a complete classified list of customers, such a list would still have been worth while. For example, every customer for a particular classification of casting can be sent a copy of any new catalogue or booklet issued in connection with that particular class of casting. This means that the literature is only sent to the people who actually need it, or are likely to be interested. The same applies to price notification. One has a mailing list for every type of casting one makes. Again, it is of value to the sales manager to know the comparative figures. If there are 340 customers for stainless-steel castings and only five customers for heat-resisting steel castings, it is obvious that something is wrong with the selling of heat-resisting steel castings, and this must be investigated and remedied. One can conceive other uses for a classified customer list of this type; but the above will serve as examples.

When one comes to the use of the list for sales analysis, however, additional information on the cards becomes essential. The first task is to ascertain and record the type of business in which each of these customers is engaged, and, wherever the information is readily available, the use, if known, to which he puts the castings. This information will not be gathered together quite so readily as the names and addresses; but it is important and worth obtaining. A capable girl clerk can do this work expeditiously and well by consultation of letter-heads, directories, and the like.

Now the fundamental purpose of this elaboration is primarily to increase sales, and the way in which this is to be done is by a careful investigation of the types of business using the castings. Let us assume, for example, that out of 40 customers for heat-resisting castings, 20 are furnace builders, three make glass and glassware, two are potters, and 15 are chemical engineers of one sort or another. One has thus an interesting set of facts at one's disposal. What use is one to make of them?

Active Sales Promotion

The first use is to get together as many trustworthy and up-to-date directories and guides as one can, and turn up the lists of furnace builders. Strike out the names of all those who are already buying the castings. You may find that you have 50 furnace builders of whom 40 are already purchasers. What about the other ten? Can they not be roped in? And the same with glass and pottery works and chemical engineers.

Here the active work of sales promotion sets in. The ten non-purchasing furnace builders are listed, and split up into representatives' districts. Each representative is then written to. The letter points out the existence of a market among furnace builders for heat-resisting steels, and gives the names of the few firms in the particular representative's district who are not actually purchasing. The representative is asked (1) whether he can or will call upon those in his territory, (2) if he knows whether it is useless to approach certain of them, (3) if he cannot call in the near future; has he any objection to the despatch of a sales letter? The letter goes on to indicate the particular type of castings in heat-resisting material which furnace builders have bought, *e.g.*, burners, ladles, nozzles, firebars, and the like, with, if the salesman is not specifically technical, a brief indication of what purpose these parts serve, and the conditions the castings have to meet.

If the representative calls and reports, well and good. The matter of eventually roping in these odd firms can be left to the sales manager and representative together; the sales-promotion man has done his job. But if the representative agrees to the writing of sales letters, then some more hard work has to be done.

The essence of this form of approach is that it must be more specific than, say, a general circular or sales letter. One is attacking a particular industry or series of industries, and it is necessary to give the impression not merely that one has castings to sell, but that one knows what one is talking about, realises the needs of the industry to which the letter is being written. Now a very good plan of action is to prepare a blue-print of typical castings of the sort furnace builders buy, and enclose this, or mechanically-reproduced facsimiles of it, with your letter. Give by all means all the talking points you can about your castings, and the purposes for which you recommend them. But bring in, in the body of the letter, as prominently as possible, the names of the kinds of castings you are actually making and selling to furnace builders all over the world. Do not, for example, say merely that you offer heat-resisting steel castings; say, on the contrary, that you are regularly supplying burners, tubes, carbonising boxes, firebars, and whatever other parts you know of, in your special XYZ heat-resisting steel. That tells. It convinces the customer you know what he wants castings for; shows him that you are actually doing business with his rivals or contemporaries; and creates in his mind a feeling that you are good people to whom to apply.

Inclusion of Selling Literature

Where the number of customers in a particular industry to whom you are *not* selling your castings is a large one, the letters can, of course, be duplicated; such duplication should be expertly done by organisations specialising in the work. It is a good plan to enclose, in addition to the blue-prints, what are technically called broadsides. These are large advertising pamphlets specially designed to create a striking impression. An article on these and their preparation, with some examples, may be given later in this series. But whether broadsides are available or not, some literature should accompany the letters.

Where the number of non-purchasing customers is small, the letters can, of course, be individually written. They should seldom run to more than two pages.

This is the genuinely scientific way of increasing sales, and by methodically attacking industry after industry in this way it is inevitable that new customers will be added to the books. Far too many founders never dream of asking themselves why they should have received an order from a basket-maker, say, nor dream of seeing if they can sell to other basket-makers throughout the world.

Scientific and Industrial Research

CONFERENCE IN LONDON

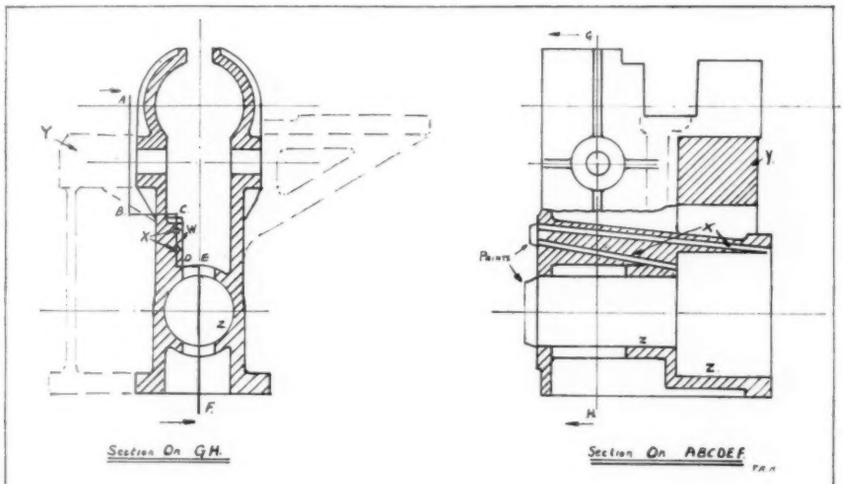
The conference held on March 22 in London, convened by the Department of Scientific and Industrial Research to provide an opportunity for discussion of the present position and future of the Research Association movement, was attended by over 100 representatives of the 21 Research Associations formed under the auspices of the Department. Lord Rutherford presided.

The views expressed left no doubt as to the importance of co-operative industrial research as carried out by the research associations, both as a means of bringing the benefits of research to the smaller units which form the bulk of British industry and of providing in the case of those undertakings large enough to maintain their own research establishments, a method for the exchange of experience and discussions of manufacturing difficulties. It was made clear that the research associations had already made a deep impression on British industry, not only in producing practical results of very great monetary value, but in bringing about a more sympathetic attitude towards the usefulness of scientifically-trained men in the works. Great emphasis was laid on the paramount duty of research associations of carrying out the long-range investigations. Several speakers drew attention to the benefit conferred on the consumer by the improvements in products as regards quality and price, and to the raising of the standard of living resulting therefrom, and for this reason urged that a continuation of a substantial contribution from Government sources was fully justified. Attention was also drawn to the importance of achieving stability of finance for the research associations as a means of securing the best work from the workers employed and of ensuring that the best scientific brains were available for their service, and of making possible the planning of long-distance programmes.

A Foundry Problem

By T. R. Harris.

Whilst the determination of the correct metal analysis for certain jobs may become somewhat easy owing to their having only to fulfil one purpose, occasions arise where different characteristics are required in the same job, and the determination becomes more difficult. An example is shown in the attached sketch, and shows two views of a special type of forging machine. The left-hand view is a section through the plane GH, looking in direction of arrows, with some of the detail which appears higher up the body shown in chain lines, while the right-hand view is a section through the planes AB, CD, EF. Z shows the cylinder, which is required hard to withstand wear,



occasioned by the friction of the piston acting under the pressure of compressed air. Y is the anvil block, and this must be capable of withstanding the impact of the forging hammer, whilst a large number of stresses are set up in the casting as a whole. From a survey of the sketches it might be said that the design is not good from a foundry viewpoint, and that would be perfectly true, whilst a study of the original drawing would reveal thick and thin sections in juxtaposition, as well as the heavy anvil block and fragile port cores indicated. But although the foundry could see these faults one at least had to be made. So in this case, as in others of a similar nature, the only logical proceeding is to strike a compromise in the analysis, and endeavour to get as hard and clean a cylinder bore as possible without impairing the strength of the anvil block. Having determined the percentage of the various pig-iron and scrap available, another problem remains as to what temperature the job should should be cast. The weight of the finished casting was 21 cwts. The first one was cast with "hot metal," that is as hot as it came from the cupola to ensure a clean cylinder bore, which item was successful. One snag remained, however, and that was in connection with the ports X. Although surrounded with metal of practically even thickness on three sides, the fourth side was comparatively very thin at W, being only ½ in. thick because of other details of the machine having to work in the space, and the increased thickness would not have left any clearance. The ports were 2 in. dia., and one was 2 ft. 6 in. and the other 1 ft. 8 in. long, both made in one with the main cylinder bore core. After machining this cylinder it was found that the longer port had buckled in its length because of the expansion of the core irons, and bulged through the ½-in. metal, thus scraping the casting. It was decided to try another with the port cover severed from the main core, and provision made for any expansion of the core iron by keeping a space above the core filled with cotton waste for this purpose. Also the metal temperature was lowered considerably for this casting. The port core remained comparatively straight, but the cylinder bore was rather bad. On trying hotter metal for a subsequent one the old trouble reappeared. Being impossible to get the design modified, it was decided to dispense with sand cores for the ports and use 2-in. dia. iron pipes cast in position. These were made bright all over to guard against disturbance in the mould during casting and so risking a dirty cylinder, and were placed in prints in the bottom of the mould and studded in position. These were then filled with parting sand. Another precaution taken in this case was to lighten out a portion of the anvil block believing that a sounder job would result. This job was cast with "hot metal" and overcame the difficulty successfully. Although an exact chemical analysis of the metal used is not now available, it was made up of equal parts of Scottish and Indian pig and 66 per cent. of good high-class machinery scrap; a separately cast test-bar gave a tensile strength of 15 tons per sq. in. The above example is one of many freak designs the foundry is often called upon to produce by designers, who do not know or will not give sufficient thought to the problems encountered in the foundry, and it shows how time and material can be wasted before a successful casting can be produced from such designs, for it will usually be found that given time and pressure of circumstance the foundry can produce almost anything, but not as a paying proposition.

Publication Received

Safety Hints on the Use of Wood-Working Machinery. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 1d. net.

It should not be imagined that the price of this 16-page booklet is indicative of its worth. Actually, it is full of common-sense "dodges" designed not only to reduce the incidence of accidents but to improve the general efficiency of the pattern shop. It should certainly find its way into every foundry, making its own patterns, in the country.

Scrap Scarcity Continues

By "Onlooker"

In spite of a rather firmer tone in the markets for new metals, scrap continues to be very scarce, and the tonnage becoming available for sale is nothing like sufficient to satisfy demand, which has expanded as trade has improved. These periodic changes in supplies of scrap appear to go in cycles, for it is not so many years since we had more scrap than we knew what to do with, and it is very likely that this present shortage will eventually be resolved into something like a glut, for consumers are perforce having to learn how to do without old metal.

To some extent, of course, the scarcity is sectional in its application, for America appears to have plenty of scrap, and the Custom smelters have been melting large quantities of old copper for conversion to new metal. Quite a proportion of this was formerly exported to the Continent and to Britain, but the chaotic state of the exchanges upset this business, and so the junk dealers and others having secondary copper to dispose of, got rid of it, so to speak, on their doorsteps, by sending it into the refineries, and thus avoided the cost of ocean freight to the Old World. Germany, having some weeks ago prohibited the export of scrap, has now put up a barrier against imports of copper and is apparently to pursue a policy of glorious isolation as far as copper is concerned. How this will turn out remains to be seen, but it may put a check on the exports from this country. France is, however, continuing to buy brass swarf at good prices and our own market is being kept short accordingly.

Aluminium scrap is not left long without a buyer, and the cast material is fetching a good price owing to activity in the motor-car trade. New sheet cuttings are being taken up readily, and much of this stuff is being ingoted for sale at a substantial discount below the price of virgin aluminium. Gun-metal scrap is far from plentiful, while, owing to increased activity among consumers of nickel, cupro-nickel scrap is being sought for and is decidedly scarce at advancing prices.

Reference has already been made to the falling-off in imports of scrap from America, but it is no exaggeration to say that merchants engaged in importing scrap into this country are up against serious difficulty on account of the obstructions placed in their way by the Customs authorities. Representations have been made in the right quarter, but the official mind either cannot or will not grasp the essential points of the problem, and so the trade continues to suffer. This is obviously a matter so hedged about with difficulties of a technical nature that it is unreasonable to expect the Customs authorities to tackle it unaided, and the wisest course would be to co-opt the services of one of the large manufacturing houses whose knowledge would speedily straighten matters out.

Some slight improvement is to be noted in the rate of activity of the ship-breaking yards, but this service of supply, usually a very important one for the scrap trade, is providing only a fraction of the tonnage formerly available. Dockyard and arsenal sales, too, are not yielding so well as they did, and there is no indication of any change for the better here, while the railway companies are not putting any great quantities forward for sale. All this is making things difficult for the scrap-metal dealers, and it is no wonder that some of them contend they are living on their losses! One point in connection with the present situation must not, however, be overlooked, and that is, the factor of a growing tendency among those making scrap to return it to the factory supplying the metal, for credit on contra account. To that extent there does exist an invisible supply of old metal, which is all to the good at this difficult time.

The Casting of Albanoid

Albanoid is a nickel silver of standard composition, which was placed on the market in order to facilitate the production of reliable nickel silver castings.

Castings produced from Albanoid are uniform in colour and properties, because the nickel, copper and zinc contents are maintained within close limits. The alloy contains approximately 20 per cent. nickel.

Melting

Albanoid melts at 1,095 deg. C., and should be poured at 1,250 deg. C. to 1,400 deg. C. Various types of furnace are capable of giving these temperatures, but it is essential that melting should be done fairly quickly and a suitable flux used in order to prevent undue absorption of gases. In a furnace running at a suitable temperature, an 80 lb. heat should need a melting time of approximately 1½ hours. If the melting takes appreciably longer, the flux will not prevent gas absorption, and porous castings will result.

Most brass foundries are equipped with coke-fired pit furnaces, and these are quite suitable for melting Albanoid. The draft should be as good as possible and the furnace bottom and flues kept clear of clinker. Special types of furnace built on girders are recommended, as they give a very efficient draft. Hard coke of the best quality is necessary (not gas coke), and the pot should be placed on a solid bed of burning fuel and packed carefully. If the scrap employed is bulky it should be charged first, and pigs, heavy gates, etc., placed where they can warm through before adding. In some localities use is generally made of a "Trunk," *i.e.*, the upper portion of a disused crucible: it is placed on top of the pot, packed round with coke and the whole of the charge is added. When the metal has run down sufficiently to allow of its removal, the coke round the trunk is rammed round the pot and no further coking should be needed. In this way a saving in melting time can be made, but the chief advantage lies in the fact that the metal is raised steadily to its melting point. Any serious check due to the addition of cold metal or the removal of the pot from the fire for re-coking may lead to faulty castings. The pot must be covered during melting and the metal covered with a flux, a suitable one being 80 per cent. borax and 20 per cent. boric acid. A proprietary flux, "Borocalcite," may be used instead, and gives excellent results.

Other types of furnace suitable for melting Albanoid are gas-fired crucible furnaces and oil-fired furnaces, all of which are capable of rapid melting.

The inventors of Albanoid recommend the use of plumbago pots, owing to their rapid heat conduction, and any good make may be employed. With care, an "ordinary rapid" pot will melt 14 to 15 heats before it becomes useless for Albanoid, but such pots can always be used again for melting brass, bronze or low-grade nickel-silvers.

It should be remembered, however, that whilst "super-rapid" pots may shorten the melting time, they occasionally suffer from the disadvantage of losing their heat too quickly during pouring. An efficient type of furnace uses about ½ cwt. of coke in melting 80 lbs. of Albanoid.

Deoxidising

Although Albanoid jackie pigs contain a slight excess of manganese, it is advisable to deoxidise the heat immediately before pouring. The most useful deoxidant for general foundry work is magnesium; a sufficient quantity is ½ oz. per 80 lbs. of metal. Henry Wiggin & Company, Limited, Thames House, Millbank, London, S.W.1, carry magnesium in stock and can supply with jackie pigs if required. It is of the utmost importance, when making this addition, that all the magnesium be pushed under the surface of the molten metal. Their practice is to form a loop in the end of a ¼-in. rod and insert the magnesium stick, the loop is then hammered up so that the magnesium is held tightly. The correct time to add the deoxidant is when the charge has melted and is ready for pouring. The rod, prepared as above, is pushed right down to the bottom of the pot and the metal then well stirred. After two or three minutes the metal may be poured. The rod must not be left in the pot, or iron may be dissolved. The use of a plumbago stirrer is recommended instead of an iron bar. No time must be lost in getting the metal into the moulds, once the pot has been removed from the furnace.

Pouring

When the pot is ready for pouring, the slag should be skimmed off with a bent iron rod, care being taken to remove as much as possible. It is a good plan to hold the skimmer on the surface of the metal during pouring, to keep back any extraneous material. Pouring should be continuous and as quick as possible.

Moulds

It is not necessary to use a special sand, and ordinary fine moulding sand as used for brass casting is quite suitable; new sand should be used sparingly. Care should be taken that the facing is not rolled or toughened too much. For cores it is recommended that sea sand be used mixed with the minimum quantity of a good paste or oil. It is advisable, and in the case of intricate moulds essential, to dry both the cores and mould before use. Moulds should be vented freely in order that gases may be expelled on cooling.

At the moment when the pouring commences, the mould is, of course, filled with air. As the metal enters the gate this air is forced out through the vents. At the same time large volumes of gas are generated by the hot metal coming in contact with the facing, or dressing, of the mould; this also must be allowed to escape freely if perfect castings are to be obtained, hence the necessity for vents, and care should be taken to see that they come from all the awkward corners of the castings where "pockets" are likely to be formed.

A very important point in casting Albanoid is the provision of runners of adequate proportions. Since the metal is poured at temperatures up to 1,400 deg. C., it cools very rapidly, and a small runner may result in imperfect castings, or the mould may not be filled. It is a useful rule to make runners twice the size of those provided for the same casting in brass. This is particularly important in the case of small castings, and many failures have been due solely to this cause. An allowance of ¼ in. per foot should be made for contraction.

Chill Castings

The moulds should be warmed and dressed with a mixture of rape oil and charcoal of the consistency of cream. To protect the bottom of the mould brush with a mixture of fireclay and water.

Use of Scrap

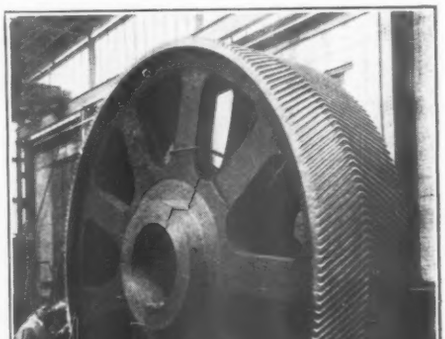
Scrap may be used up to 50 per cent. of the charge, the remainder being new jackie pigs. Sheet scrap, as well as runners, gates, etc., can be used up, but should be balled up into as small a space as possible to minimise the surface oxidation which takes place in the pot before the scrap has melted down. Scrap which has been soft soldered should not be used; if machine shop turnings are used, care must be taken to see that they are free from other materials. It is not advisable to use swarf.

Cases of Unsoundness

Trouble.	*Possible Causes.*
General porosity.	Slow melting. Incorrect deoxidation. Faulty venting, etc.
Fractures in casting, or mould not filled.	Risers too small. Metal poured too cold. Sand too tight.
Sand burned into casting.	Metal poured too hot. Mould too wet. Poor surface dressing.
Large dark blowholes.	Overheating. Impurities in scrap.

A Large Gear Wheel

Our illustration shows what is probably the largest gear wheel of its kind ever cast in one piece, the product of David Brown & Sons (Huddersfield), Limited, of Huddersfield. This wheel weighed over 24 tons (finished), and, as will be seen, it has nine pairs of channel section arms. The central boss, as-cast, is provided with three small gaps to relieve contraction strains, and is machined to accommodate turned steel hoops, which are shrunk-on finally after the slots have been filled or otherwise spaced.



View of Finished Gear Wheel.

The double-helical teeth (203 in number) are cut from the solid, the face width being 3 ft. 4 in. and the overall diameter approximately 13 ft. 7½ in. The wheel was machined and cut at the works of David Brown & Company from a casting supplied by the English Steel Corporation, and it is now being incorporated in a 91-in. single-reduction gear for a rolling-mill drive overseas. The normal speed of the wheel will be about 35 r.p.m. As a matter of interest, the peak loads liable to be encountered in this drive may be in the neighbourhood of 10,800 h.p.

Grinding and Polishing

Some years ago an institute of grinding and polishing technology was established at Brunswick as a branch of the technical college. The first research report has now been issued by this institute and deals with the terminology of grinding and polishing by Dr. A. Danz. The definitions are practical rather than philological, and deal wholly with metal handling, covering every branch of the industry.

This Week's News in Brief

Trade Talk

It is expected that steel production at the Brymbo Steelworks, Wrexham, will begin on May 7 or 14.

During last year Denmark exported various iron and metal goods to the value of 19.2 million kr., compared with 14.5 million kr. in the previous year.

Mr. C. H. V. Wilson informs us that on and after April 14, 1934, his address will be 39, Cautley Avenue, Clapham Park, London, S.W.4.

The Sheffield Corporation Water Committee has placed a contract with the Clay Cross Company, Limited, for concrete-lined cast-iron pipes.

Owing to increased business, the Crittall Manufacturing Company, Limited, has recommenced operations at its Maldon, Essex, factory, which had been idle for two years.

The Blaenavon blast furnaces have been restarted, and Messrs. Bradley & Foster, Limited, Darlaston Blast Furnaces, Darlaston, are acting as distributing agents.

At the annual general meeting of Carron Company's works Welfare Club, Mr. H. Medcalf presided and reviewed very fully the club's activities during the past session. The session has been what is probably the most successful in its history.

Mr. Victor B. Reichwald, agent in Great Britain and Ireland for Messrs. Ehrhardt & Sehmer, of Saarbrücken, makers of steelworks plant, has removed from 120, Moorgate, London, E.C.2, to Terminal House, 52, Grosvenor Gardens, S.W.1.

Foundry Equipment, Limited, inform us that owing to the rapid extension of their business they are moving into larger premises on Saturday, April 21. Their address from that date will be 17, Victoria Street, Westminster, S.W.1, and their telephone numbers, Victoria 3396 and 3397.

According to a message from Moscow, the Soviet Government has decided to send special commissions to London, Paris, Berlin and New York, to buy machinery of a total value of $2,000,000, destined for the heavy industries of the Urals. Mining machinery will be bought in Great Britain, it is stated.

The L.N.E.R. have placed an order with Messrs. H. Lees & Company, Limited, Glasgow, for a 250-ton electrically-operated coaling plant for Norwich. The L.N.E.R. have also placed orders for a large tonnage of steel with nine firms, including Messrs. Colvilles, Limited, and the Steel Company of Scotland, Limited.

The Carborundum Company, Limited, Trafford Park, Manchester, have appointed Mr. E. A. Cartwright to represent them in Lancashire, Cheshire and North Wales for Carborundum and Aloxite brand grinding wheels. Mr. Cartwright has been connected with the Carborundum Company, Limited, for over twelve years.

A reduction in unemployment is reported by the United Patternmakers' Association. Mr. Alan Findlay, general secretary, states that the number of unemployed is 1,398, compared with 2,568 a year ago. The number on transitional benefit has been reduced from 1,102 to 572 in the same period. The reduction is mainly due to improved conditions in the shipbuilding industry.

For the convenience of Lancashire foundries Messrs. J. Parish & Company, of Erith, announce the inauguration of a regular boat service of Erith loam and the creation of a stock of all grades from which supplies may be drawn. In this connection they have appointed the Milward Trading Company, of 26, Corporation Street, Manchester, 4, as their general agents.

A series of heavy machine tools has been completed by Messrs. James Bennie & Sons, Limited, Clyde Engine Works, Govan, for the Russian Government. These tools, which are for use in Soviet shipyards, are part of a considerable order booked by Messrs. Bennie at the end of last year, and they are now ready for shipment to Russia. The remaining portion of the order will be completed within the next few months.

Messrs. Williams Simons & Company, Limited, Renfrew, have received an order to construct a powerful twin-screw suction hopper dredger for the Basrah Port Directorate through the Crown Agents for the Colonies. The dredger will be over 300 ft. long and arranged for dredging to a depth of 45 ft. The vessel will be classed Lloyds 100 A1, and her construction will be under the supervision of Messrs. Coode, Wilson, Mitchell & Vaughan-Lee, of London.

The Excelsior Iron and Steel Works (John Williams & Company (Wishaw), 1922, Limited), Wishaw, have been taken over by a new company, which will assume control at the beginning of next month. Mr. John Williams founded the works 76 years ago for the manufacture of steel nails, wire nails, wire, washers, buckles and buckle pins and rolled sheet and strip. Mr. Williams came from Staffordshire and took with him a number of skilled men. He was succeeded in the business by his sons, two of whom remained associated with the business until their deaths. Mr. Alfred H. Williams died at Helensburgh in 1931, aged 73 years, and Mr. John Williams, J.P., died in October, 1932, at the age of 76.

A marked improvement in trade is taking place in the Springburn district of Glasgow, where some of the former employees of the North British Locomotive Company, Limited, many of whom have been idle for a long period, resumed work at the firm's Hyde Park Works. A night shift has been started in several of the shops, and as the work advances in various departments, more of the former employees will be absorbed. The firm has on order over 100 locomotives, 50 of which are for the L.M.S. Railway Company and 50 for South Africa. It is rumoured that there is a possibility of the Queen's Park Works being restarted shortly.

A reflection of the favourable turn of trade in the light-castings industry in Falkirk is found in the annual report of the Ironfounding Workers' Association for the year 1933. The figures given reveal how substantially the number of unemployed was decreased during the year, especially among moulders. From the beginning of the present year until about the middle of February the position was not quite so heartening, and the unemployment figures showed a tendency to rise again. Since then, however, the position has steadily improved, each week showing an addition to the numbers reabsorbed into employment, until at the present time the figures are almost as good as at the end of last year. The outlook is regarded as distinctly bright and the confident belief prevails that the next few months will see a material accession to the numbers in full employment.

Personal

Mr. A. Avison, who has lately held the position of London manager of Messrs. David Brown & Sons (Huddersfield), Limited, and previous to that was chief estimator at the firm's head office, has been appointed sales manager of the company.

Lord Herbert Scott was elected President for the ensuing year at the annual meeting recently of the Federation of British Industries. He succeeds Sir George MacDonogh. The following additional Vice-Presidents were elected :—Mr. Bernard Docker, of Birmingham Railway Carriage & Wagon Company, Limited; Sir Francis Joseph, of Settle. Speakman & Company, Limited; and Mr. Charles Mitchell.

Surrounded by descendants to the third generation, Mr. and Mrs. William H. Hardy celebrated their golden wedding this week at Eaglescliffe. Mr. Hardy, now in his 78th year, was head of the firm of Messrs. J. J. Hardy & Sons, Limited, brassfounders and engineers, of Hartlepool, a business that was founded by his father under the original title of Messrs. Hardy & Pattison at Middleton, Hartlepool.

Wills

Kennedy, William, formerly of Glasgow, brassfounder	£8,544
Hamilton, Peter, retired steelworker, 173, Croftfoot Road, Cathcart, Glasgow	£2,886
Reid, Walter Montgomerie Neilson, director of the North British Locomotive Company, Limited	£77,019

Company Reports

British Oxygen Company, Limited.—Final ordinary dividend of 6½ per cent., making 9 per cent., less tax, for 1933.

Parker, Winder & Achurch, Limited.—Loss, after depreciation, £4,938; brought in, £2,555; from reserve, £5,000; preference dividend, £990; carried forward, £1,626.

Company Meetings

Rivet, Bolt & Nut Company, Limited

In the absence of Sir John Hunter, the chairman, Mr. William Crosher (vice-chairman) presided at the annual meeting of the Rivet, Bolt & Nut Company, Limited, held in Glasgow. Mr. Crosher, in moving the adoption of the report and accounts, said they found themselves for the first nine months of the year seeking the world over for orders to enable them to maintain their various plants on a restricted output. In the last three months of the year things did take a turn for the better, but too late to counterbalance the depressing effect of the earlier period. He was pleased to say that the improvement still remained with them, and the work in sight would keep them going moderately well for some months, so that the outlook for this year was certainly promising. The effect of competition from the welding process upon the rivet industry was raised by a shareholder. In reply, the chairman said that they could not stop progress. He hoped that the expansion of world trade would nullify the amount of work that was being taken up by the welding process.

Hadfields, Limited

The annual meeting of Messrs. Hadfields, Limited, was held in Sheffield recently. Sir Robert Hadfield, Bt. (chairman of the company), who presided, said that the first eight months of last year were only slightly better than the previous 12 months. Happily a favourable turn of events then followed, with much more hopeful results. There was good reason to hope that the reorganisation plans of the National Federation of Iron and Steel Manufacturers would render service of the highest value to the industry. Even to-day thousands of tons of iron and steel were imported into this country annually. The present condition of affairs was more or less unique, and extraordinary measures were required to meet the present situation and stem such an import of foreign products which we ourselves were quite well able to manufacture. The chairman added that there was in these days much talk about research, and rightly so. It had been stated that British metallurgy was not progressive enough and was behind the times. This was a most unfair statement, seeing that this country had led the way for the last 150 years in all major inventions, not least among them being the introduction and development of alloy steels, which had proceeded from Sheffield. His firm and he certainly led the way in the development of manganese steel, silicon steel and a number of other special alloy steels. In Sheffield they were ever willing to learn on sound scientific lines backed up by practical experience.

Obituary

Mr. William Burgess, of Dollar, who was employed as a brassfounder with Messrs. R. Willison, Alloa, for many years, died suddenly last week.

The death occurred, in Greenock, on April 7, of Mr. George Darroch, chief draughtsman with Messrs. Hastie & Company, Limited, Kilblain Engine Works and Caledonian Foundry, Greenock. Mr. Darroch, who was in his 66th year and unmarried, had been with Messrs. Hastie for 20 years. Previously he was engaged in Petrograd with the late Mr. Llewelyn Davies, a director of Messrs. Cochran & Company, Limited, Annan. Later he held an important position with the Thames Ironworks, London, for about 15 years.

Contracts Open

Droitwich.—2,500 yds. 8-in. steel water pipes and specials, 1,300 yds. of spun-iron water pipes with flexible joints, and 70 yds. spun-iron water pipes with spigot and socket joints, for the Town Council. Mr. R. E. Hulse, borough engineer and surveyor, Droitwich.

Egypt, May 2.—20-in. and 24-in. cast-iron pipes, 12-in. steel pipes, manhole covers and step irons, etc., for the Ministry of Public Works. The Department of Overseas Trade. (Reference G.Y. 13,675.)

South Africa, May 23.—Pumping plant, for the Electricity Department of the City of Cape Town. The Department of Overseas Trade. (Reference G.Y. 13,670.)

XUM

Raw Material Markets

Recently-published statistics relating to the iron and steel industry clearly illustrate the strong recovery that has been made. Last month's output of steel amounted to 829,700 tons, the highest monthly total since October, 1929 (889,800 tons). The March output of iron (503,600 tons) was also a considerable improvement on previous months. Current business continues at a good level, and the outlook is promising.

Pig-Iron

MIDDLESBROUGH.—The output of iron in this district is moving fully into consumption, and is also well booked ahead, the consuming trades having plenty of work on hand. Export business has picked up slightly in one or two directions, but is still very limited. A satisfactory feature of the situation from the ironmasters' point of view is the increase in the average realised price of Cleveland iron, owing to the operation of the minimum-price scale. The fixed home prices are based upon No. 3 Cleveland G.M.B. at 67s. 6d. per ton delivered Middlesbrough. Delivered to other areas, No. 3 foundry pig is quoted: North-East Coast, 69s. 6d.; Falkirk, 67s. 3d.; Glasgow, 70s. 3d. per ton. Half-a-crown more than the foregoing figures is charged for No. 1 foundry iron, while 1s. per ton less than No. 3 is charged for No. 4 foundry and No. 4 forge iron.

Although the output of East Coast hematite is at the highest level for years, and although export business is still very restricted, the current production is fully absorbed by the heavy home demand. The makers are heavily booked forward, and are adhering rigidly to the new zone prices, which are based upon No. 1 hematite at 68s. per ton delivered Middlesbrough, 70s. delivered Durham and Northumberland, 79s. delivered Birmingham, 75s. delivered Scotland and 76s. delivered Lancashire, mixed numbers being 6d. per ton less than No. 1 quality.

LANCASHIRE.—Business in pig-iron has lately been on the quiet side, but a fair number of contract renewals is expected to come out shortly. Producers report that the rate of deliveries to this district is satisfactorily maintained. For delivery in the Widnes district, Derbyshire, Staffordshire and North-East Coast No. 3 are all quoted at 72s. 6d. per ton, with the rest of Lancashire on the 74s. basis, while Northamptonshire foundry iron is quoted at 72s. 6d., and Derbyshire forge at 69s. to approved users and a minimum of 70s. to foundries. Slow conditions are reported in respect of Scottish foundry iron in the Lancashire district, with offers in the region of 83s., delivered Manchester or equal.

MIDLANDS.—The demand for iron has now resumed its normal volume. The consuming trades are well occupied, and it is expected that a buying movement will develop towards the end of this month, or the beginning of the next. There have been no alterations in the prices of ordinary foundry irons, and the present minimum rates applicable to Birmingham and Black Country stations, and subject to rebate for large consumers, are 67s. 6d. per ton for Northants No. 3 and 71s. for Derbyshire, Staffordshire and Lincolnshire No. 3. Iron for the general engineering and motor trades is being consumed in better tonnages, but no further changes in prices have taken place. Scottish No. 3 is rated at about 87s. 6d., low-phosphorus pig from 82s. 6d. to 90s., and medium-phosphorus from 75s. to 80s. per ton delivered this area. The present price for refined pig-iron is £6 15s. to £7 15s., according to analysis.

SCOTLAND.—An additional furnace was blown in last week on hematite. Of the 15 now in blast in Scotland, five are on foundry iron, five on basic and five on hematite. The demand for Scottish foundry remains slow. The official minimum of 70s. per ton f.o.r. furnaces is still in force for No. 3, with 2s. 6d. extra for No. 1. Good quantities of foundry iron, both English and Scottish, are being used in the Falkirk area. No. 3 Cleveland is quoted at 67s. 3d. at Falkirk and 70s. 3d. at Glasgow, other English irons being 1s. 3d. per ton below these levels.

Coke

The coke market exhibits no change. Prices in the South Staffordshire area are firmly maintained, as follow:—Best Durham foundry coke, 36s. 6d. to 40s.; Welsh, 36s. to 45s. per ton, delivered Midland areas.

Steel

Conditions in the steel markets appear to be slowly gathering strength, and, while the greater portion of the business transacted by the British steelworks is with home users, recently there has been an improvement in the inquiry from oversea, states the official report of the London Iron and Steel Exchange. Business in semi-finished steel has been steady, and the works producing this material are well employed. Most consumers have covered their requirements for some time ahead and are buying on a hand-to-mouth scale. Competition in the home market from foreign material, however, is almost negligible. Business in the finished-steel department has been active, and in some sections of the market there is pressure to secure deliveries. The heavy steelworks are busier than for a long period, and are assured of employment for some time to come. Export inquiry has been on a slightly better scale lately, and a fair proportion has developed into business, although transactions for the most part are limited to comparatively small parcels.

Scrap

The demand for cast-iron scrap in the Cleveland district is limited, consumers being well stocked. Sellers' quotations are 53s. per ton for good machinery metal, 50s. for ordinary heavy cast iron and 45s. for light metal. There is a steady demand in the Midlands, where heavy machinery in handy sizes is offered at 55s., good heavy at 50s. and clean light metal at 47s. 6d., all delivered works. Reports from Scotland indicate that heavy machinery cast-iron scrap is quiet at 57s. 6d. to 58s. 6d., with ordinary cast, suitable for cupolas, in pieces not exceeding 1 cwt., at 54s. to 55s.

Metals

Copper.—Quotations have remained firm in the standard market, there having been no new development of any importance. The consuming industries in Europe are quite well occupied on the whole, whilst the industrial demand for copper in this country continues to expand gradually. With regard to the March statistics, estimates vary, but it is generally agreed that world deliveries last month reached the highest level for years, stocks showing a considerable fall during the same period.

Daily quotations:—

Cash.—Thursday, £33 7s. 6d. to £33 8s. 9d.; Friday, £33 6s. 3d. to £33 7s. 6d.; Monday, £33 to £33 1s. 3d.; Tuesday, £33 to £33 2s. 6d.; Wednesday, £33 to £33 1s. 3d.

Three Months.—Thursday, £33 11s. 3d. to £33 12s. 6d.; Friday, £33 11s. 3d. to £33 12s. 6d.; Monday, £33 5s. to £33 6s. 3d.; Tuesday, £33 3s. 9d. to £33 5s.; Wednesday, £33 3s. 9d. to £33 6s. 3d.

Tin.—The future of prices in this market continues to hinge on the possibility of an increase in the export quotas of the producing countries. The effect of the restrictions now in operation is seen in the higher prices which have ruled lately on the London market, and in the fact that consumers are being asked to try brands other than those they are accustomed to.

The consumption of tin in the United States remains very good. The tinplate mills in that country are operating at over 80 per cent. of their normal capacity, compared with the 55 to 60 per cent. of capacity being worked by the tinplate industry in South Wales.

Market prices:—

Cash.—Thursday, £238 17s. 6d. to £239; Friday, £238 12s. 6d. to £238 17s. 6d.; Monday, £236 12s. 6d. to £236 15s.; Tuesday, £238 5s. to £238 10s.; Wednesday, £239 5s. to £239 10s.

Three Months.—Thursday, £237 5s. to £237 10s.; Friday, £237 to £237 10s.; Monday, £235 10s. to £235 15s.; Tuesday, £236 15s. to £237; Wednesday, £237 10s. to £237 15s.

Spelter.—There has been no new development in this market. The galvanising industry remains depressed, and its consumption of spelter very limited. This is partially offset, however, by the increased activity at many European brassworks. The market is well supplied with metal at the moment.

Day-by-day prices:—

Ordinary.—Thursday, £14 17s. 6d.; Friday, £14 18s. 9d.; Monday, £14 17s. 6d.; Tuesday, £15 1s. 3d.; Wednesday, £15 2s. 6d.

Lead.—There are at last signs that the very dull conditions which have prevailed for so long in the cable industry are gradually giving way to a more active tendency. Consumer demand generally—particularly in this country—continues to be favourable, but, strangely enough, this has had no influence on the price. In America, on the other hand, although the stock position has recently become less favourable, the price has been raised to 4.25 cents, after having remained unchanged at 4 cents since the beginning of the year, report Messrs. Brandeis, Goldschmidt.

Market fluctuations:—

Soft Foreign (Prompt).—Thursday, £11 11s. 3d.; Friday, £11 11s. 3d.; Monday, £11 11s. 3d.; Tuesday, £11 10s.; Wednesday, £11 11s. 3d.

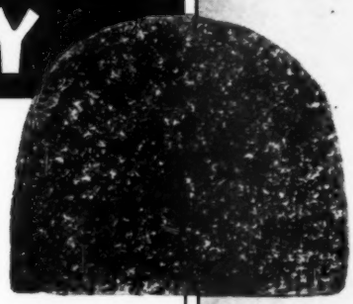
Manufacturing Railway Locomotives in India

In reply to a question in the Indian Legislative Assembly, the Financial Commissioner for Railways stated that the possibility of manufacturing locomotives and boilers in India is being investigated for the Railway Board. Metre-gauge locomotives were constructed in the Ajmere workshops of the B.B. and C.I. Railway. The recent figures of the cost of engines constructed in Ajmere did not show that they were cheaper than the current prices for manufacture in Great Britain.

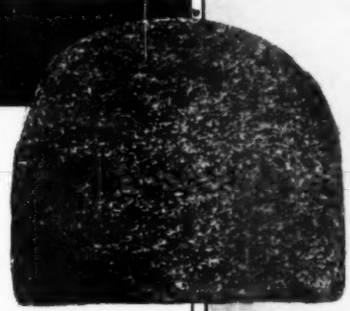
CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

K.H. BRAND PIG IRON

FOUNDRY



FORGE



BASIC

FOR MORE THAN HALF A CENTURY THE ***K.H.*** **BRAND** OF FOUNDRY AND FORGE PIG IRON HAS ESTABLISHED A REPUTATION FOR SUPERIOR QUALITY KNOWN AND ACCEPTED THROUGHOUT THE TRADE.

ITS RELATIVELY LOW SULPHUR AND PHOSPHORUS CONTENTS, COUPLED WITH ANY DESIRED SILICON LIMIT, MAKE IT EMINENTLY SUITABLE FOR FIRST CLASS ENGINEERING WORK.

Full details and prices on application.

THE LANCASHIRE STEEL CORPORATION LTD

IRLAM.
Telephone: 11.
Telegrams: Steel Phone, Cadishead.

WARRINGTON.
446
Lancasteel, Warrington.

RAW MATERIALS—PRICE LIST

(Wednesday, April 18, 1934)

COPPER

	£	s.	d.
Standard cash	33	0	0
Three months	33	3	9
Electrolytic	36	2	6
Tough	34	15	0
Best selected	35	5	0
Sheets	62	0	0
India	43	15	0
Wire bars	36	5	0
Ingot bars	36	5	0
H.C. wire rods	38	5	0
Off. av. cash, March	32	10	8 3/16
Do., 3 mths., March	32	15	1 1/16
Do., Sttlmnt., March	32	10	7 7/8
Do., Electro, March	35	15	1 3/8
Do., B.S., March	35	10	10
Do., wire bars, March	36	0	0
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	239	5	0
Three months	237	10	0
English	240	0	0
Bars	241	0	0
Straits	241	15	0
Australian	241	5	0
Eastern	240	17	6
Banca (nom.)	242	15	0
Off. av. cash, March	233	19	2
Do., 3 mths., March	232	11	8
Do., Sttlmt., March	233	18	9 5/7

SPELTER

	£	s.	d.
Ordinary	15	2	6
Remelted	15	0	0
Hard	12	10	0
Electro 99.9	17	5	0
English	15	15	0
India	14	10	0
Zinc dust	19	0	0
Zinc ashes	3	5	0
Off. aver., March	14	17	8½
Aver. spot, March	15	0	7 7/7

LEAD

	£	s.	d.
Soft foreign ppt.	11	11	3
Empire	11	15	0
English	12	15	0
Off. average, March	11	13	10 3/7
Average spot, March	11	10	10 5/7

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do., V.M. ex whse.	23	0	0
Rods	29	0	0

ANTIMONY

	£	s.	d.
English	39 0 0 to 40	0	0
Chinese, ex-whse.	33	0	0
Crude	21	0	0

QUICKSILVER

Quicksilver .. 10 10 0 to 10 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.
Ferro-silicon—			
25%	8	17	6
45/50%	13	0	0
75%	18	2	6
Ferro-vanadium—			
35 50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free of Mo.	5/6 per lb.		
Ferro-titanium—			
23/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£14 10 0		
Ferro-tungsten—			
80/85%	2/9 lb.		
Tungsten metal powder—			
98/99%	3/- lb.		
Ferro-chrome—			
2/4% car.	32	0	0
4/6% car.	23	0	0
6/8% car.	21	12	6
8/10% car.	21	12	6
Ferro-chrome—			
Max. 2% car.	37	10	0
Max. 1% car.	38	15	0
Max. 0.70% car.	42	0	0
70% carbon-free	10½d. lb.		
Nickel—99.5/100%	£225 to £230		
"F" nickel shot	£202 10 0		
Ferro-cobalt, 98/99%	5/3 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11	5	0
76/80% packed	£11 15 0 to £12	5	0
76/80% export (nom.)	£9	15	0
Metallic manganese—			
94/96% carbon-free	1/2 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to ⅛ in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	2	13	6 to	2	15	0
Bundled steel and shrngs.	2	7	6 to	2	15	0
Mixed iron and steel	2	8	0 to	2	10	0
Heavy cast iron	2	5	0 to	2	6	0
Good machinery				2	7	6
Cleveland—						
Heavy steel				2	7	6
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	10	0 to	2	13	0
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	12	0
Scotland—						
Heavy steel	2	11	3 to	2	12	6
Ordinary cast iron	2	14	0 to	2	15	0
Engineers' turnings				2	2	6
Cast-iron borings	2	1	3 to	2	2	6
Wrought-iron piling				2	12	6
Heavy machinery	2	17	6 to	2	18	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	28	0	0
Brass	20	0	0
Lead (less usual draft)	10	10	0
Tea lead	8	0	0
Zinc	9	10	0
New aluminium cuttings	70	0	0
Braziery copper	25	0	0
Gunmetal	26	0	0
Hollow pewter	155	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	5	0 to	8	0	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	15	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	5	0 to	9	10	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	5	0
Galv. cor. shts. (,,)				12	15	0
Galv. flat shts. (,,)				13	5	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft				5	10	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	1.85
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.35
Barbed wire, galv.	3.10
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/3 to 16/9
,,	28×20 ,,	32/6 to 33/6
,,	20×10 ,,	23/6 to 23/9
,,	18¾×14 ,,	17/3
C.W.	20×14 ,,	15/-
,,	28×20 ,,	31/- to 31/3
,,	20×10 ,,	21/6 to 21/9
,,	18¾×14 ,,	15/- to 15/6

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
April	12	33	7	6	inc. 1/3
,,	13	33	6	3	dec. 1/3
,,	16	33	0	0	,, 6/3
,,	17	33	0	0	No change
,,	18	33	0	0	,, ,,

Electrolytic Copper

		£	s.	d.	
April	12	36	10	0	dec. 2/6
,,	13	36	5	0	,, 5/–
,,	16	36	0	0	,, 5/–
,,	17	36	0	0	No change
,,	18	36	2	6	inc. 2/6

Standard Tin (cash)

		£	s.	d.	
April	12	238	17	6	inc. 2/6
,,	13	238	12	6	dec. 5/–
,,	16	236	12	6	,, 40/–
,,	17	238	5	0	inc. 32/6
,,	18	239	5	0	,, 20/–

Tin (English ingots)

		£	s.	d.	
April	12	239	10	0	No change
,,	13	239	5	0	dec. 5/–
,,	16	237	5	0	,, 40/–
,,	17	239	0	0	inc. 35/–
,,	18	240	0	0	,, 20/–

Spelter (ordinary)

		£	s.	d.	
April	12	14	17	6	inc. 1/3
,,	13	14	18	9	,, 1/3
,,	16	14	17	6	dec. 1/3
,,	17	15	1	3	inc. 3/9
,,	18	15	2	6	,, 1/3

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
April	12	17	0	0	No change
,,	13	17	5	0	inc. 5/–
,,	16	17	5	0	No change
,,	17	17	5	0	,, ,,
,,	18	17	5	0	,, ,,

Zinc Sheets (English)

		£	s.	d.	
April	12	24	0	0	No change
,,	13	24	0	0	,, ,,
,,	16	24	0	0	,, ,,
,,	17	24	0	0	,, ,,
,,	18	24	0	0	,, ,,

Lead (English)

		£	s.	d.	
April	12	13	0	0	No change
,,	13	13	0	0	,, ,,
,,	16	13	0	0	,, ,,
,,	17	12	15	0	dec. 5/–
,,	18	12	15	0	No change

Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in March and the three months, 1934, compared with a year ago.

	March.		Three months.		March.		Three months.	
	1933.	1934.	1933.	1934.	1933.	1934.	1933.	1934.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron, forge	—	—	—	—	—	—	—	—
,, foundry	3,862	1,839	11,520	8,442	12,225	5,233	36,774	24,017
,, acid	26	—	37	—	159	—	226	—
,, basic	1,100	4,170	6,131	14,771	3,025	11,062	16,865	39,313
Total (including other kinds)	4,988	7,006	17,688	27,558	15,409	22,147	53,865	88,941
Castings and forgings	125	289	326	529	2,613	6,336	7,858	13,768
Cast pipes and fittings	47	133	254	394	1,098	8,807	5,604	22,240
Stoves, grates, etc.	91	78	172	196	7,963	8,302	16,460	19,219
Baths	386	652	996	1,955	9,388	15,440	22,992	46,585
Hollow-ware, all kinds	179	175	495	614	7,918	9,533	20,216	32,108
Exports.								
Pig-iron, forge	107	125	521	249	370	515	2,115	1,018
,, foundry	3,436	6,806	9,361	15,709	12,713	22,769	33,667	54,729
,, acid	5,723	2,957	11,083	8,724	17,143	9,303	33,735	27,329
,, basic	160	—	735	565	568	—	2,940	1,820
Total	9,426	9,888	21,700	25,247	30,794	32,587	72,457	84,896
Castings and forgings	218	471	593	1,074	7,815	19,238	25,922	42,906
Cast pipes and fittings, up to 6 in. diameter	3,542	4,275	10,850	13,057	37,557	46,985	121,330	150,574
,, ,, ,, over 6 in. ,,	2,532	6,000	7,814	11,228	18,907	43,005	55,790	86,262
Stoves, grates, etc.	465	733	1,447	2,110	22,461	31,629	66,873	102,039
Sanitary cisterns	170	230	590	714	5,237	6,771	17,304	20,440
Bedsteads, inc. tubes therefor	440	444	1,040	1,309	16,433	13,539	40,410	43,001
Cast hollow-ware	375	319	1,018	858	15,510	10,542	41,397	32,032

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Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

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